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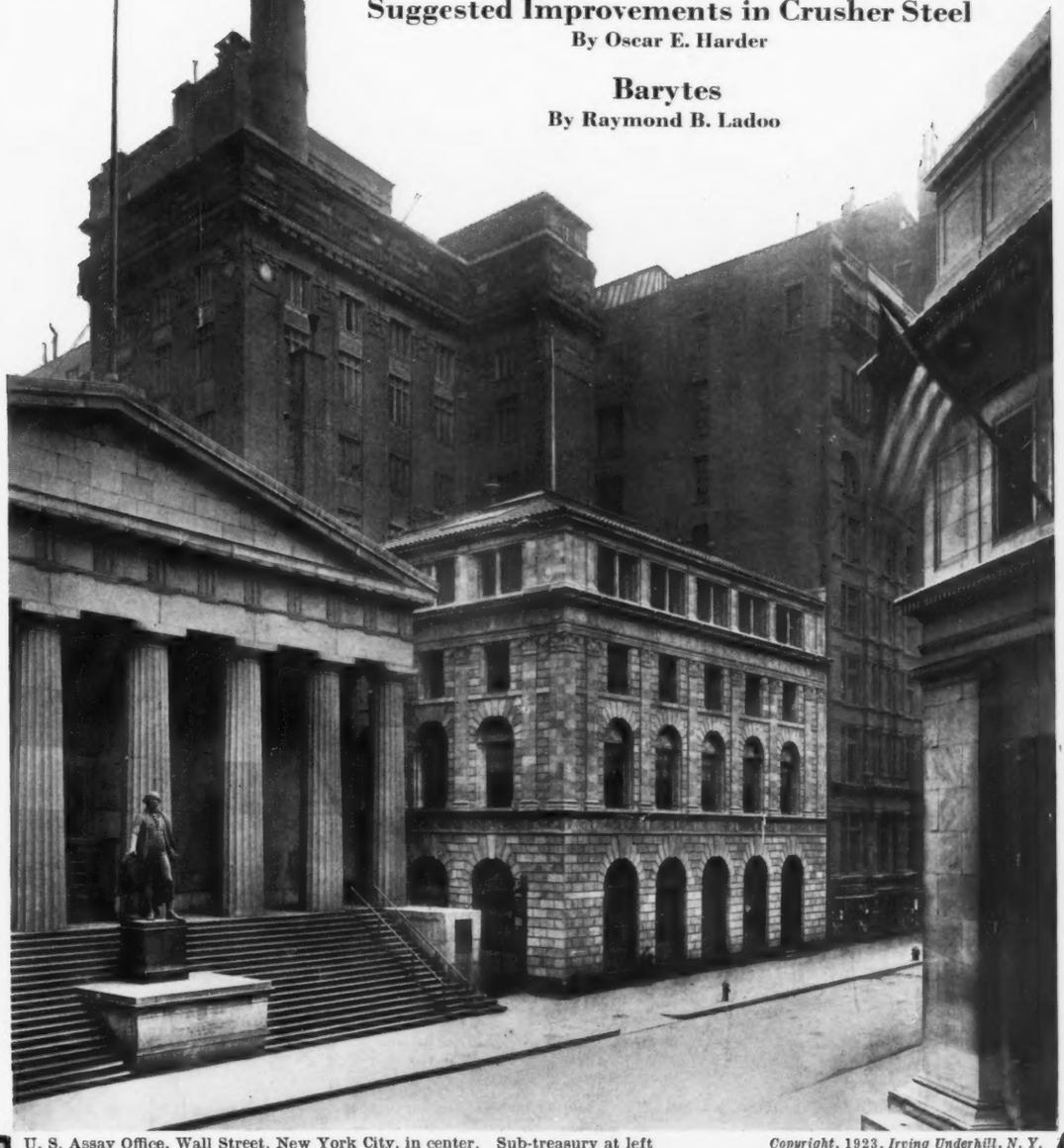

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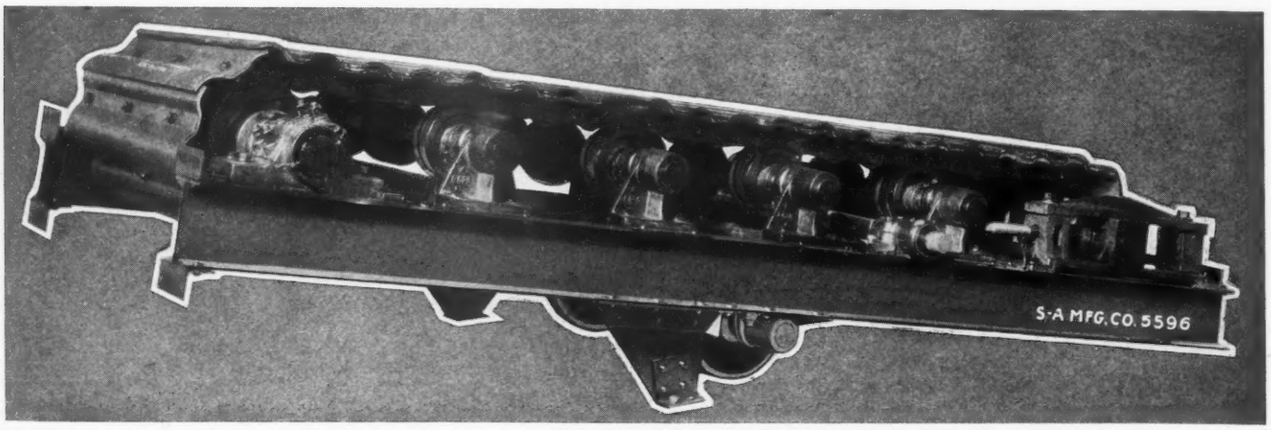
A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

February 17, 1923



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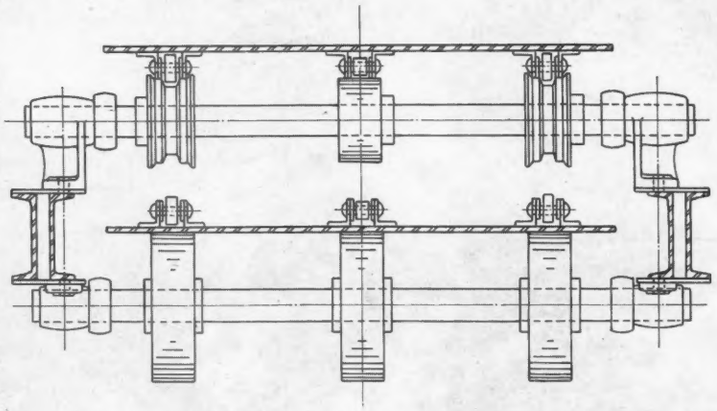

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 115 | New York, February 17, 1923 | *Number* 7

The Metallic Iron of Greenland

THAT polar continental island, Greenland, is notable from the mining standpoint for two things—for being the only important habitat and source of the mineral cryolite, a fluoride of alumina and soda, used as an ore of aluminum; and for the renowned occurrence of lumps of metallic iron, which are found in the basalts of the region. Metallic iron has been recorded in other parts of the world, but never in such quantity as in Greenland; and the occurrences of cryolite outside of Greenland are of academic interest only. Here there is a problem for geologists to explain—why these minerals occur so outstandingly in Greenland and nowhere else. A most excellent account of the situation is given by Dr. Sydney H. Ball in a paper on the "Mineral Resources in Greenland," just published in Copenhagen.

Since Nordenskiöld in 1870 found boulders of metallic iron, the largest of which weighed twenty-three tons, in the Greenland (Ovifak) basalt, the fact has been of lively interest to scientists and the source of much speculation. The analogy with the native iron of meteorites was, of course, quickly pointed out; and therefore an outstanding theory of the origin of the Greenland iron was that it represented deeply buried earth material, brought up by the molten basalt; and that it gave a key to the nature of the substance of the inner earth. The known character of the earth as a magnet would seem to support this theory, and the fact that the magnetic pole is situated in the general region of the pole of the earth's axis of rotation—the North Pole. Another consideration favorable to this theory is that the specific gravity of the earth (5.55) as a whole is twice that of the superficial crust with which we are familiar (2.77), suggesting that the core may be in part at least metallic.

The alternative explanation for the Greenland iron is that the iron which is common to basaltic magmas, in the form of silicate, has been reduced to metallic form by carbonaceous material. The basalt traversed, in its passage to the surface, Cretaceous strata which are coal-bearing. The basalt itself contains a notable quantity of graphite. Moreover, graphite is contained to a very striking degree in nearly all the older rocks of the region, whether gneissic or igneous, including those of presumably pre-Cambrian age, so that Dr. Ball observes that "there is probably no region in which the mineral is more widely distributed, nor in which it occurs in more varied associations." Graphite occurs in basalts, pegmatites, gneisses, schists, limestones, and shales, in Greenland.

The last-named theory of the origin of the metallic iron—through reduction by carbonaceous material—is apparently the view preferred by Dr. Ball.

A circumstance detracting from the argument for deep "telluric" origin of the metallic iron, by the analogy with the meteorites, is the fact that meteoric iron is practically an iron-nickel alloy, containing anywhere from 4 to 60 per cent nickel, while the Greenland iron contains, at most, under 3 per cent. Moreover, the magnetic pole is not in Greenland, but in the region north of Hudson Bay; so that from this standpoint we cannot argue that the metallic core of the globe comes nearest the surface in Greenland, where the magnetic declination of the compass, or deflection of the needle from the true north toward the magnetic pole, amounts to 65 degrees westerly.

Our jury system is based upon the belief that a man previously unfamiliar with a problem is the most impartial judge when both sides are presented to him. Reviewing the field, therefore, we feel at liberty to say that we are impressed in favor of the view that the metallic iron of Greenland is simply the result of reduction of ordinary basaltic silicate iron by carbonaceous material, presumably contained in the basaltic magma. Greenland is not rich in iron; on the other hand, it is very notably rich in graphite—in that it is phenomenal, as Dr. Ball points out. The native iron would seem to be most probably a symptom of this phenomenal circumstance; and this would narrow future investigation down to what would seem very likely the real problem—the cause of a phenomenally carbon-rich petrographic province.

A Useful Controversy

SENATOR PITTMAN and Mr. F. H. Brownell, of the American Smelting & Refining Co., have been exchanging views about the silver situation in which fundamentals are involved deserving the closest attention by silver miners. Senator Pittman, among other things, contends that the smelting company is not interested in the formation of a selling and credit association and in the price of silver, because it buys and sells silver at the market price and is satisfied with a smelting profit. Mr. Brownell in a rejoinder defends the smelting company in a forceful manner. He emphasizes the fact that the smelting companies—note the plural—are all interested in the silver market as miners of the metal besides being smelters; furthermore, that a high price of silver stimulates production and consequently encourages smelting, with which process these organizations are mainly concerned.

An export or credit association would not be successful, according to Mr. Brownell, because the production of silver has a small influence on price, and the history of many attempts to artificially control the price of silver shows that they have resulted disastrously. But the chief value of Mr. Brownell's remarks lies in his sound treatment of the silver currency situation—the "steady remorseless increase of the discontinuance of its use as money." That is the real peril that faces the silver producer, and the appeal that is made to the United States Government to use its influence in the councils of the nations to support and fur-

ther the cause of silver during the next few critical years should be strongly supported by all interested in the welfare of the silver-mining industry. It is a call to use our efforts to help restore sanity in the European currency madness. Verily, European countries are circulating almost everything but wood in their monetary debauch. Unfortunately, in modern monetary systems nothing can prevent nations from issuing copper, nickel, aluminum, iron, or other cheap metallic coins should they so desire. They can maintain composition coins in circulation as easily as they do paper and by the same authority and methods. The principal danger to a lavish use of the base metals in currency lies in the easier counterfeiting possible of cheap coins with a high face value, but then face value is so low at present that they are not worth imitating.

Black as the situation abroad appears, we have an idea that the pendulum already has swung too far in the direction of the free use of currency hardly worth the trouble of minting. The native Russian and German knows well enough the intrinsic value of a silver coin, and doubtless many a hiding place contains a secret hoard. Through years of constant use silver has demonstrated its fitness to serve as a currency, notwithstanding the extreme price fluctuations in 1920, which affected its exchange. It is an ideal metal for coinage purposes, it does not tarnish, and has a relatively high bullion value. If we could only get away from the use of silver as token money—a difficult problem—the metal would be held in greater esteem. At present, though its physical properties are as "noble" as those of gold, gold sits at the altar while silver occupies a rear pew. Were it not for the great disparity in the rate of production of these metals, this condition would be altered.

How to overcome the silver miner's dilemma is indeed puzzling. What he wants is action, something that will relieve the tenseness of the present situation, something that will not leave him with a dark outlook when the repurchases of silver end. Let him then encourage, for the time being, his representatives in Congress to aid in currency stabilization in Europe. Gradual and insistent pressure and a wider understanding of the situation, as we have repeatedly urged, and as outlined by Mr. Brownell, will help.

Disarmament in Central America

THE FIVE Central American republics, sitting at Washington, reached an agreement which was a long step forward, providing for adjustment of existing differences and the prevention of future bickering, as well as revolutions.

Somewhat more spectacular than real, however, was the disarmament convention whereby the army of each republic was limited to a number ranging from 2,000 for Costa Rica to 5,200 for Guatemala. As a matter of fact, the standing army of one of these republics, at least almost a year ago, consisted of four generals, twelve colonels, two captains, and nineteen men. We are not joking. As for Nicaragua, whose army is limited to 2,500 men, a single company of American marines, stationed in the capital as a "Legation Guard," has long maintained an easy military ascendancy. The political "outs" bitterly complain that they could "revolute" if the marines would only go. The grand gesture of disarmament, therefore, is what O. Henry has prepared us for.

Protecting the Small Investor

A NEW MINING ENTERPRISE, as a legitimate and profitable field for investment, is unlikely to appeal to the small-scale capitalist until the industry is freed from the menace of the stock-jobbing promotor and the inexperienced operator. The "man in the street" cannot be expected to distinguish the good from the bad—the swindle from the meritorious proposition; it is unfortunate that he is in no position to determine if an invitation to subscribe to a new company is merely a bait to hook the unwary—to part the simpleton from his roll—or an opportunity for him to invest his money to advantage.

Mining, and particularly precious-metal mining, has an unsavory past in this respect. In England, for many years, the mining engineer found himself looked down upon by the civil engineer, whose professional escutcheon was untarnished. In time, however, mining engineering came to be recognized as a legitimate and honorable vocation; it attracted technologists of high rank and undoubted ability; it contributed engineers of integrity and unusual resourcefulness to the Great Cause; and so its professional organization sought the privilege and prestige that would be conferred under an incorporation by royal charter.

In spite of an honorable record during recent years, however, the snobbery of a sister organization asserted itself, and there was much opposition, all of which was finally overcome, the charter being granted in 1915. Whereupon the Institution of Mining & Metallurgy assumed an additional dignity and was empowered with the responsible task of upholding the honor of the profession and protecting the industry from charlatans and confidence-trick men who would claim to be mining engineers and metallurgists. The Institution, not having been devoured by the bug of irresponsible expansion, is a professional society in every sense of the term. The investing layman who is in doubt as to the merits of a promotion in the mining industry inquires the name of the consulting engineer or metallurgist. If he finds that no member of the Institution is connected with the concern, he probably abstains from further interest. If a member's name is being used as a guarantee, the would-be investor feels secure in the knowledge that summary action would be taken by the council of the Institution in the event of irregularity or fraud. Further, he has the assurance that, as a member of the Institution, the engineer or technician responsible is necessarily a person of training, experience, and probity. The public, therefore, is guarded against the unprincipled crook, on the one hand, and the crazy "inventor" on the other.

In the United States, membership in our national Institute carries no guarantee; and the council, in its efforts to convert the society into a successful and competitive commercial organization, has neither the time nor the inclination nor the power to act in a general way to protect the investing public, to conserve the capital available for legitimate mining enterprise, to encourage and to protect the professional standing of those trained engineers and technicians who are included in its ranks.

The issuance of stock in mining enterprises is under rigid control in some states, to the chagrin of many promotors. Excellent work is being done by the California State Corporation Department, for instance, in curbing the mercenary exploits of the irresponsible or the unscrupulous. In New York, however, the financial center

of the United States and the home of the Institute, there seems to be no limit to which one may go in an effort to amass capital, ostensibly for the furtherance of mining or metallurgical schemes whose naked absurdity lacks even the proverbial fig leaf of technical justification. The money thus being collected would make a Ponzi envious; yet the promotors continue in their careers of prosperity, bobbing up when occasion demands, retreating from the game when the dupes become restive, only to reappear under another guise when the coast is clear.

The mining industries of the United States can ill spare the capital that pours in a continual stream into the wrong channels; they do not deserve the odium that accrues because of the improper actions of those who are outside the ranks, who degrade the profession in the eyes of the public.

What none of the mining organizations can or will do by disciplinary action, the *Journal-Press* intends to do by publicity. For this task we bespeak the moral support of the profession in an effort to stamp out irresponsible promotion by those who are ignorant of technology, contemptuous of ethics, or unprincipled enough to mislead deliberately the unsophisticated investor. Thus we hope to protect the practicing engineer, to divert and encourage more capital to flow in the direction of legitimate mining investments, and to purge the mining industry of any possible taint of chicanery and humbug.

The Nicaraguan Canal

SECRETARY WEEKS supports the proposal to dig a new canal by the Nicaraguan route, using the income from the Panama Canal for that purpose, so far as it will go. This is a wise plan, and should proceed forthwith. Before the Panama Canal was dug, it was a great question as to whether the Nicaragua or the Panama route should be chosen, and political and financial considerations were said to have contributed to the final choice. European diplomacy reached out, however, and German intrigue sought to control the Central American republics and the route through Nicaragua. The danger of this was so strong that the United States bought from Nicaragua an option on the Nicaragua route and has ever since been sitting on the lid in Nicaragua. Even the pacific Bryan, when Secretary of State, landed marines at Bluefields to quell a hopeful revolution.

The new canal will tie up the East and West coasts more closely commercially; it will reduce the railroad problem, too closely allied to labor duress; it will be an essential means of military defence. During the late war the blowing up of the Panama Canal was one of the enemy objects.

The Alaskan Railroad

THE recent completion of the bridge spanning the Tanana River, in Alaska, marks the final construction of the government railroad from Seward to Fairbanks. It is an event of importance not only to the interior region of Alaska but to the nation. The work of building this Alaskan railroad, 468 miles long, was begun in 1915, and has cost over $56,000,000. We hope that it may mark a new and fortunate departure in the development of a great mining region in this territory of the United States.

Europe and Mineral Treasure

IN EUROPE the tangled mesh of affairs shows no sign of unraveling. A common understanding is as far from that continent as it was in the time of Charlemagne. We worry about the indigestion of our own melting pot: but the common mixture which only can save Europe is impossible. There is no eutectic combination. In the bewildering snarl run threads of racial bigotry, economic stress, class hatred, language barriers, religious variance and intolerance, and greed. "The only trouble with Europe," writes a correspondent who has been in the field for many years, "is the Europeans." Europe appeals to America for help—by that they mean money. They do not want advice; and if they had money it is apparent that they would wage war with it.

Two of the principal maelstroms of the situation revolve around the fundamental question of mineral wealth. Germany and France are still playing the game for the border provinces. Germany, having been vanquished in battle, still hopes and schemes for an economic victory, even though she has lost the iron mines of Alsace Lorraine and the coal and zinc of Silesia. Somehow she will beat France yet. In response France seizes the coal mines of the Ruhr, as provided in the treaty of Versailles. Now, indeed, she would appear to have played a trump card—if the game does not break up in a general row.

In the Near East, an underlying cause of struggle is the petroleum district of Mosul, which lies north of Mesopotamia. Over Mesopotamia the British were given a mandate, which they henceforth defined far differently from what President Wilson conceived it. Mosul is in Turkish territory, and the Turks want to retain it. Mosul has long since been the cause of strained relations between England and France, and in the Treaty of Rapallo a division of the spoils was agreed upon. But that was on the theory that Turkey was dead. The real owner having come to life, and very much to life, he is informed that as his possessions have been divided, under the impression that he had passed away, they cannot be returned. England is apparently willing to wage war for petroleum; and France would like it, but not to the point of war in the Near East. She is quite busy fighting the iron-coal war now in progress on her own borders.

There is little honor among thieves. What is colloquially known as "double-crossing" is the order of the day in European diplomacy. They are all busy at it. France "double-crossed" England when she made a separate treaty with the Angora Government; Greece "double-crossed" her allies when she broke the general peace and started to wipe out the Turks in Asia Minor; England "double-crossed" France in the efforts of the latter to enforce the Versailles treaty. Germany of course has been hopefully trying to "double-cross" France, but, after all, France is an avowed enemy, while the Allies were supposed to be friends, and to work shoulder to shoulder for "civilization and democracy." Those who fell on Flanders fields are not resting quietly in their graves.

> "Take up our quarrel with the foe!
> To you from failing hands we throw
> The torch; be yours to hold it high!
> If ye break faith with us who die
> We shall not sleep, though poppies grow
> in Flanders fields."

Spitsbergen

By T. A. Rickard

IN THE course of reviewing 'America in Spitsbergen' I have assembled some notes on this Ultima Thule. The island extends to latitude 80° North, or within 600 miles of the Pole; therefore it has served as a point of departure for many Polar expeditions, including Andrée's ill-fated attempt with a balloon in 1897 and Wellman's fiasco with a dirigible balloon in 1909. In later years several mock-heroic expeditions—Scottish, German, and Swedish—imposed rescue operations upon the American company that operated the coal mines from 1905 to 1915. Spitsbergen means 'pointed hills', and was so named by Barents, a Dutch navigator, in 1596. The climate is softened by the Gulf Stream, which flows past the British Isles, along the coast of Norway, and then turns northward to Spitsbergen, the consequence being that the Arctic ice is held back so as to render navigation practicable during the summer. Excursion steamers visit Spitsbergen, and occasionally their passengers feel the thrill of adventure when the pack-ice threatens to hold them in its grasp. The name of Spitsbergen applies to a group of islands, the largest of which has an area of 15,000 square miles. The chief port of departure to Spitsbergen from the continent of Europe is Tromsö, in Norway, which is 550 miles south of Advent Bay, the principal settlement on the islands. From there to London the distance is 1750 miles.

From the time of Eric the Red, who discovered the islands in 986, to our own day Spitsbergen has been claimed by various nations, but no permanent occupation ensued until recently. During the 17th century the islands became a centre for whale-fishing and walrus-hunting, which continued with moderate success until 1912, by which time the slaughter of whales and walruses put an end to a profitable industry. During these three centuries Spitsbergen was visited by hunters, explorers, and naturalists, representing many nations, all of which at one time or another laid claim to sovereignty. Annexation was attempted more than once, but no permanent occupation ensued, because the islands offered no scope for permanent industry until the early part of this century, when Spitsbergen was recognized as a *terra nullius*, or No Man's Land. There had been rumors of mineral wealth, and stories were told of deposits of coal, iron, gold, marble, lead, copper, graphite, alabaster, and guano, but none of these except the coal has proved to be of commercial value. If they had been found valuable there would have been a more intensive scramble for territorial possession. Rights of property were precarious and the rivalries of various squatters caused clashes, as might be expected. Possession was nine points of the law and there was no appeal except to force, the equivalent of piracy. The matter of national ownership came to a head when the American coal company established itself on the chief island. A joint control by an international commission would have involved too great a financial burden on the only industry—the coal mine. The Norwegians were anxious to gain possession, and there was much to be said in their behalf. In July 1910 a conference at Kristiania recommended that Spitsbergen be recognized as a neutral territory under an international police. Nothing came of this. Then it was suggested that an international corporation be organized for the purpose, but this was deemed dangerous because the majority of the stock might be acquired by one nation. In June 1914 another international conference met to settle the question, but it failed because Russia refused to agree to recognize the existing rights to property. In 1915 the American coal mine was acquired by the Norwegians. This helped to decide the question. During the Peace Conference at Versailles in 1919 it was decided that, owing to its nearness to Norway and the large investment made there by Norwegians, Spitsbergen should belong to Norway. The decision was logical and fair.

The glaciers come down to the sea and choke the bays even in summer. The temperature of the air ranges from 55° F. to —40° F. Extreme variations occur within 24 hours. Fierce winds during periods of great cold are the worst menace to human life. Inside the coal mine the thermometer registers 38°. Visitors are surprised to find not a black but a white mine, because the moist air when chilled deposits a sparkling layer of frost over the walls of the workings. This is due to the fact that the air is warmer than the rock, which, from information obtained by me in 1913, has a temperature of 22° to 23° F., summer and winter. In 1913 the main entry of the mine was 2200 ft. long and had attained a vertical depth below the surface of 800 ft. At that point the seams of coal were separated by thin sheets of ice that looked like plate-glass. Ice is a visible sign of extreme cold where there is moisture. Dry rock would give no outward sign of its low temperature. The subterranean coldness of the Spitsbergen mine was the evidence of a Glacial period, that is, one during which the summer thaw is unable to overtake the winter frost. The sequel to such a period can be seen in northern Alaska, where the ground remains permanently frozen for hundreds of feet; the maximum thaw extends only for five or six feet during the four months of summer, and each winter undoes the work of the sun. In Australia there was a Glacial period even so late as in Permian time; then came an era when the summer heat thawed the ground deeper than the winter cold could penetrate; during successive warm seasons the thaw extended farther, until at last all the ancient frost was conquered, and that part of the earth's crust was completely liberated from ice, except occasionally and surficially during the winter. The distinction is between the permanent ice of a geological period and the temporary frost of a terrestrial season. The question arises, how far will frost penetrate the crust of the earth? The ultimate depth to which the frost will extend must depend upon the conductivity of rock, the mean temperature at the surface, and the rate at which heat escapes from the interior of the earth. The increment of heat in depth varies greatly; it is greatest in volcanic regions and in those of expiring volcanism, the average however being about 1° F. per 200 ft. of depth. Calculations show that for frost to extend to 800 ft., the mean annual temperature would have to be 12° below the freezing-point. The mean air temperature of Spitsbergen from 1872 to 1912, according to Dr. G. Rempp, of Weisenburg, was 15° F. below freezing. Therefore it is probable that frozen ground, with ice as the evidence of that condition, will be found at a depth greater than the 800 ft. as yet attained.

DISCUSSION

The Klondike Discovery

Former Mining Recorder Narrates Facts Supporting Claim that Henderson First Struck the Bonanza

THE EDITOR:

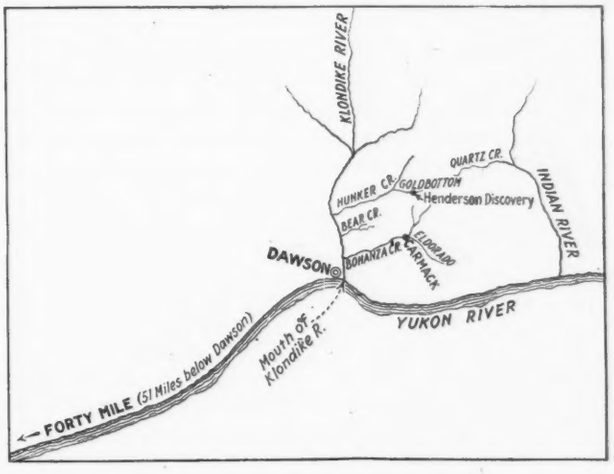
Sir—Mr. Wanless, at The Pas, has shown me the article *re* the Klondike discovery written by Alex McComber, published in your issue of Dec. 9, 1922, and has requested me to give the proper version of the event. As I happen to be the only Canadian Government official alive today who resided at Forty Mile at the time of the Klondike discovery, and as my duties as Recorder acting for Captain Constantine, the Gold Commissioner, brought me in direct contact with the original stakers, I feel that I am competent to state at first hand what actually occurred.

Before beginning, I cannot refrain from suggesting to the readers of Mr. McComber's narrative that they forget it *in toto*. It is ridiculously untrue and very misleading. I hold no brief for either Bob Henderson or George Carmack, but simply state the facts so that the reader may judge to whom to give credit.

In the spring of 1896, Bob Henderson left Forty Mile with the previously avowed intention of prospecting the upper tributaries of Indian River, especially Quartz Creek. Somewhere up the Yukon River he fell in with three newcomers — namely, Swanson, Munson, and Dalton — and persuaded them to join him. They journeyed up Indian River, thence up Quartz, and from the head of this creek crossed the divide into Goldbottom. Here they prospected and found a little gold, enough to encourage them to remain. Running rather short of food, Henderson, knowing he was in the Klondike watershed, decided he would go to the mouth of the river, where at that season the Indians would be catching and drying salmon. There he found not only the Indians fishing but George Carmack, his squaw, her brother, Skookum Jim, and another Upper Yukon Indian, "Tagish Charlie," occupied in the same pursuit. They were camped just below the mouth of the river at the spot where the Klondike Hotel was later built by John Nelson in Dawson. Henderson told Carmack of his find on Goldbottom and advised and invited him to come and stake; he furthermore gave accurate instructions how Carmack was to reach the camp at Goldbottom, telling him to go up the first tributary of the Klondike (afterward Bonanza) until he came to the forks, then continue up the left-hand stream about two miles, when he would come to a small creek on the left (later known as 21 Pup), follow it up and cross the divide at the head, and that he would then drop down where Henderson and his partners were working.

Carmack decided to accept Henderson's invitation. This was on Aug. 16, 1896, and he struck out for Goldbottom along with his Indian companions. On their way up the first tributary they did some panning, and at a point about ten miles up the stream found some exposed high rim rock which yielded $2 or $3 in a few pans. Carmack, instead of continuing his journey to Goldbottom, only eight miles further on, and informing Henderson of his new find, returned immediately to his camp at the mouth of the Klondike and, leaving his companions, hastened alone to Forty Mile to record his claim.

I well remember the day, Aug. 18, that he came to the police barracks and told of his discovery to Captain Constantine, officer commanding, who at that time was not only Gold Commissioner but represented all departments of the government. Carmack asked to record his discovery claim, and named the creek Bonanza, as was the privilege of the discoverer. He not having sufficient gold dust to pay the recording fee of



Sketch map of Klondike region

$15, the captain generously paid in full for him and allowed him to keep his little prospect wrapped in a small piece of paper that he might show it to the miners. For the first day or so little excitement was created, mainly because Carmack had no reputation as either prospector or miner, and men were loath to believe that he had truly made a new discovery. However, the one feature that stood out in favor of it being true was the character of the dust shown; it was entirely different in appearance to the gold of Miller, Glacier, Davis, Franklin, Napoleon, or any of the other creeks known at that time. Two or three men struck out for the new diggings and were quickly followed by a few more, and in three or four days there was a mild stampede, in which I participated, staking Fifty-three below Discovery on Bonanza on Aug. 24. About sixty or seventy men preceded me and many more followed, so that Bonanza was quickly staked. A day or two after my return to Forty Mile Andy Hunker appeared at the barracks and asked to record a discovery on a new creek which he had named after himself. Captain Constantine was at first inclined not to make

a new district of the creek, as it also was a tributary of the Klondike, and he thought that one district in the Klondike would suffice. However, he was persuaded to allow it as a new mining zone, and again I stampeded and staked on Hunker Sept. 1.

Were it not for encroaching on your valuable space I would continue on and tell of the early freezing of the Yukon on Sept. 30, how the river opened again shortly after, and how, on Oct. 16, with the most beautiful mild weather and the river absolutely free of ice, the Steamer "Arctic" took a goodly load of miners with their outfits to the Klondike. How the men started to build their cabins, settle down, and begin the first true prospecting by sinking shafts. How it was not until later on in December that the first pay was found on Louis Rhodis claim 21 above, when as much as $5 was obtained in a pan, on bedrock. How shortly after others struck it and larger and larger pans were obtained. How I made frequent trips to Dawson and recorded claims there instead of asking the miners to come to Forty Mile, which was the headquarters of the government.

At the time of the discovery, there were not more than twelve squaw men in the whole Yukon Territory, including George Carmack but most assuredly not the Bishop, whose wife was a highly educated and refined little English lady.

I consider that Mr. McComber's vaporings about Carmack panning $700 with two frying pans in two days from a bit of high rim rock, and bringing several hundred with him to Forty Mile, is almost an insult to any old-timer's intelligence. Every old Yukoner knows that there was very little pay in gravel and that there were no sensational pans until bedrock was reached.

Mr. Fred Beatty, of The Pas, was resident at Forty Mile at the time of the discovery, being one of the late William Ogilvie's Alaskan Yukon boundary survey party. He remembers well when Carmack arrived and showed his little prospect of $2 or $3. He tells me that on that same day George wanted to sell him a tanned moose skin for $3, but he did not buy, because the government supplied him with all necessary footwear.

I had the pleasure of meeting Mr. J. E. Spurr at Forty Mile in 1896 and also Mr. T. A. Rickard some years later at the Zero Club in Dawson.

The Pas, Manitoba, Canada. A. E. WILLS.

THE EDITOR:

Sir—Dr. Wills was one of the three officers of the N.W.M.P. who established the Canadian Government in the Yukon Territory in 1895. He remained with the Police until December, 1897, when he resigned and went to Ottawa as one of the delegates representing the mining interests. A few months after his return, the following summer, he became interested in Gold Run Creek along with J. A. Chute, and eventually owned nearly half the creek, comprising the wonderfully rich claims known as Nos. 9-10-11-12-12a-12b-14-15-16-17-18-19-21a-26-27-28-29 and half of 30.

Goldbottom produced considerable gold, but was not particularly rich. However, it was extensively worked. All old-timers recognize that Carmack made the discovery on Bonanza, but that Henderson discovered gold in the Klondike watershed first and less than six miles from discovery on Bonanza.

Dr. Wills is now a resident of The Pas and is practicing his profession. I had the pleasure of knowing him in the Yukon and know that his narration of the early days is correct. I also know Mr. Fred Beatty, who also resides in The Pas and can also verify the statements here made by Dr. Wills.

Having heard so much controversy as to who was the discoverer of the Klondike, and knowing it had never been correctly set out, I prevailed on the Doctor to give us this article, and I think it will dispel all doubt in regard to the question. J. M. WANLESS.

The Pas, Manitoba, Canada.

The Cost of Pebbles

THE EDITOR:

Sir—In your issue of Dec. 16 there is a short editorial on "Pebbles for Tube Mills." One gets the impression that in practically all cases the use of foreign pebbles is not justified, and you cite an instance in support of your contention. The instance you select does indeed support your contention, but, on the other hand, it is by no means proved that the importation of pebbles from abroad means invariably an unnecessary expenditure of money. You cannot say, because local or domestic pebbles cost, let us say, $1,000 per month, and foreign pebbles $3,000 per month, that the use of the former is therefore indicated definitely. You must go further into the matter and see whether the tonnage and extraction are affected and to what extent. The question is an economic one, and it must be studied from every angle and not merely from the point of view of initial cost of material.

I was glad to see your paragraphs in the same issue on "Cleanliness, Order, and Efficiency." There is in my opinion nothing so bad for morale and metallurgical results as a dirty mill. Although a badly kept mill, as you point out, may be due to faulty design, it is also in some instances due to an effort to make a mill exceed its rated capacity. Circumstances, such as a sharp rise in the market value of the mill product, may warrant even a good deal of dirt, but as a general rule there is little excuse for untidiness. It has been my experience that it is cheaper in the long run to keep things orderly. By a constant insistence on every man doing his share the mill can be kept clean at no extra expense, and the men themselves soon see the many advantages that go hand in hand with cleanliness.

San Juancito, Honduras. PAUL T. BRUHL.

"White Collars vs. Dirty Jobs"

THE EDITOR:

Sir—A correspondent writing in your recent magazine under the above heading is apparently not a mining man of the old school, and judging from the strain of his letters is laboring under many delusions regarding the standing of the young mining engineers of today.

I agree that many young mining men with a college education "know how" to shovel, dump ore, and do other work of like character, but there is a big difference in "knowing how" to do these things and then putting the knowledge into practical use. I am led to believe that Mr. Hubert's remarks made on the foregoing are largely responsible for his statement regarding the mentality of mine workers, and at this point would be glad to have Mr. Hubert's reasons when he states that a college education proves a man mentally better than the average in a mine.

May I suggest that Mr. Hubert devote a little time to the study of the wonderful work accomplished by

those splendid pioneers of '98. Very few of those old-timers were educated in colleges, but they were not found wanting; they achieved greatness beyond the measure of average mentality.

Most of us are aware of the fact that mining is not accomplished by men who wear gloves and who are habitues of beauty parlors. It is true that miners are usually found far from the beaten track, but we cannot remove them to the Broadways of our cities to suit the qualms of "an educated man who has been brought up in city life, with gymnasium, etc., whose ears are tuned to music, who wore white gloves when dancing."

The man who crystallizes out in the white-glove class is not worthy of even a job at all. He is invariably a parasite and a menace to society. GRADUATE.

San Diego, Calif.

The Standard Hoisting Bucket

THE EDITOR:

Sir—I have been interested in reading the description of the standard hoisting and self-dumping bucket by G. Cleveland Taylor in your issue of Dec. 30. I happen to have been connected with the development of this device to a slight degree, and hold it in such high appreciation as a safe and economical sinking bucket that I am glad to add a little to the history of its development, and fully indorse all the good things that have been said about it, as it is a life-saving device compared to the old form of loose crosshead swinging and spinning bucket and cumbersome trap-door arrangement.

This device in its original form was used at Neihart, Mont., by Fred Burgen prior to 1900. Mr. Burgen came to the Coeur d'Alenes about that time, and was a noted practical operator in that district. He was successively foreman or superintendent at the following mines during my sixteen years as Mine Inspector for Idaho: Tiger Poorman, Standard Mammoth, Morning, Hypotheek, and Marsh Mining Co. While at the Standard Mammoth mine he introduced the idea to Captain R. H. Pascoe, then superintendent of that property, who had a quick appreciation of such things and was a noted underground operator himself. It was developed jointly by Captain Pascoe, Mr. Burgen, and William J. Hall, who was assistant general manager for the Federal Mining & Smelting Co. and a keen student of mechanical and business details. These three men in 1909 patented the device in the United States and all important foreign countries as the Standard hoisting bucket.

Mr. Hall for the last four years has been Commissioner of Public Works for Idaho, with headquarters at Boise. He and the widows of his two former partners still own the patent, the exploitation of which has never been pushed, because of lack of means to advertise it properly.

The first application of this device was in the Standard shaft at Mace, Idaho, where it was built in the machine shops at that mine. The crosshead was strengthened and equipped with tension spring and safety clutches at my suggestion. I described and illustrated this equipment in my annual report for 1907, from drawings furnished me by Rush J. White, then chief engineer of the Federal Mining company and still a prominent consulting and operating engineer at Wallace, Idaho.

Captain Pascoe was killed in a snow-slide which occurred during the night while he was asleep in his bed at home in Canyon Creek, just above the Standard mine, during the winter of 1910. An interesting incident of Captain Pascoe's work at the Standard was the straightening of the 2,000-ft., three-compartment vertical shaft in its middle section through a 150-ft. section of heavy ground, where it had got a foot out of line. This he accomplished without checking the normal production of the shaft of 1,000 tons of ore a day. The timbering was replaced two sets at a time, on the "graveyard" shift.

Mr. Burgen lost his life in 1920 in the Russell litigation shaft of the Marsh mine by disturbing a pocket of monoxide gas that had resulted from a burnt hole on the previous shift, while he was engaged in lowering the pump a few minutes before the morning shift went to work.

The Standard hoisting bucket has been used in deepening most of the big vertical shafts in the Coeur d'Alenes since its invention. I am familiar with many kinds of hoisting buckets, but believe the Standard bucket is the safest and most efficient device of its kind that has yet been invented. It is inexpensive and safe and simple in operation; it will dump wet muck, and would be adaptable as a small skip hoisting plant with a bottom ore-pocket for shallow vertical shaft work, such as the short-lived unit operations found in the extensive southwest Missouri and Oklahoma district, where the hooker could have a much safer position to start his loads from, and the can men, in an active operation, would not have to wait so long for an empty.

Boise, Idaho. ROBERT N. BELL.

Origin of Manganese Deposits of Lunenburg County, Nova Scotia

THE EDITOR:

Sir—In the Jan. 6 issue of the *Engineering and Mining Journal-Press* an article appeared by Frederick C. Fearing on "The Manganese Deposits of Lunenburg County, Nova Scotia." In his discussion of the genesis of these deposits, the author states that he considers them geological freaks caused by downward percolating solutions from formerly overlying sediments of lower Carboniferous age, now entirely removed by erosion. This argument does not seem to me convincing. In my judgment the deposits are not of a particularly unusual type, and their origin is hence susceptible of a simpler and less involved explanation.

The deposits are described as occurring in fissures in granite. The ore ends abruptly at water level and consists of pyrolusite and manganite associated with varying quantities of iron oxide. Calcite is an important constituent, and tends to increase in quantity toward the borders of the orebodies, so that in all probability the barren and deeper parts of the veins are mainly composed of this mineral. A considerable part of the calcite is distinctly manganiferous, as, according to the author's own statement, it carries from 0.5 to 3 per cent of manganese.

From the foregoing it would seem that the most obvious explanation of the origin of these ores is that they have simply resulted from the oxidation, *in situ*, of manganiferous calcite veins. Manganese deposits of similar genesis are not uncommon in the Rocky Mountain region of the United States, particularly at Leadville, Colo., and Butte, Mont. Manganese, on account of the insolubility of its oxides, tends to accumulate in the oxidized zone.

According to E. C. Harder (Bulletin 427, U. S.

Geol. Surv.) the unoxidized ores of Leadville contain an average of not more than 1 per cent manganese of unknown mineral form, and the oxidized ores vary in manganese content from 10 to 40 per cent and averaged from 15 to 25 per cent, certainly a conspicuous enrichment.

It may be urged against this explanation that in cool, moist, highly glaciated regions like Nova Scotia ores resulting from surface agencies are practically absent. Though this is true in great measure, there do exist isolated instances of pre-glacial oxidation, which for various reasons have escaped entire removal by the eroding ice sheet.

In northeastern Labrador, A. P. Coleman (Memoir 124, Can. Geol. Surv.) has noted that the mountain tops and higher table-lands show no evidence of glaciation. At the Keeley silver mine, South Lorrain, Ont., the Woods vein, a strong mineralized fault fissure, is oxidized in places to a depth of 300 ft. or more. In this case not only the vein filling but the wall rock also is softened and decomposed for an appreciable distance. This unusual condition is possibly due to the fact that the oxidation was of such great depth that it escaped complete removal by glacial erosion. (This property is described by J. M. Bell in the *Transactions* of the Institution of Mining & Metallurgy, February, 1922). There is good reason to believe that conditions at the Lunenburg deposits are not dissimilar to those of South Lorrain. During the spring of 1917, while on examination work in Nova Scotia, I had with me, during part of my stay in the province, a miner who a short time previously had been foreman at one of the Lunenburg manganese mines. According to his statement, both the vein matter and the adjoining granite wall rock were so exceedingly soft and decomposed as to give considerable trouble in mining and necessitated the use of an unusual quantity of timber in the workings.

Finally, summarizing the evidence above noted, it seems most probable that the Lunenburg manganese deposits were formed from low-grade primary vein stuff or "protore" by the ordinary processes of oxidation and that their existence at the present time is owing to the fact that the oxidation was sufficiently deep to escape entire destruction by glacial agencies.

Cobalt, Ont. J. A. REID.

Sampling Mill Heads in Cyanidation

THE EDITOR:

Sir—In an article appearing in your issue of Jan. 13, entitled "Amalgamation, All-Cyanidation, and Thievery," the editor intimates that there is no cheap and efficient method of obtaining an accurate "mill-head" sample where the ore is ground in a cyanide solution that already contains gold. To quote, "as in several other Canadian cyanidation plants in which up-to-date methods have been adopted, the ore at this particular mill is crushed in a cyanide solution that already contains gold, thus making the cheap and efficient sampling of 'heads' impracticable."

For some years I have been using a method that I found to be exceedingly cheap and efficient. In the hope that it may be of benefit to someone who is not familiar with it, I will endeavor to explain the procedure followed.

The sample is taken at the discharge end of the ball mill, by passing a receptacle across the stream at regular intervals. The mixing in the ball mill is so thorough that once every fifteen minutes will give a high degree of accuracy. A drip sample of the grinding solution, before it comes in contact with the ore, is also taken. The specific gravity of the ball-mill discharge is determined in this manner: After thoroughly mixing and cutting, take a final sample of 500 cc. in a graduated glass cylinder of known weight. Weigh and subtract the weight of the cylinder, to obtain the weight of 500 cc. of pulp. Multiply by 2, and divide by 1,000. From a table, based on the specific gravity of the pulp, read per cent solution, and ratio dry slimes: solution. Determine weight of solution in the sample and use just that weight of water to wash out the cylinder onto a suction filter. Filter and assay the residue, filtrate, and grinding solution.

Let assay of residue be B
ratio dry slimes: solution be R
assay of filtrate be F
assay of grinding solution be F'
Then, mill heads $= B + R(2F - F') - \frac{1}{10}F$

$R(2F - F')$ is the gold dissolved in the ball mill per ton of dry slimes. The residue contains about 10 per cent of solution, so this correction must be made. This factor should be determined by means of repeated experiments.

There is no credit due me for compiling the table used. I believe it was originally worked out by some Cobalt engineers. I have simply appropriated it to my own use. It was determined in the following manner:

To determine ratio dry slimes: solution:

The average specific gravity of the ore will be known, say 2.65, which applied in Cobalt. Let the determined specific gravity of the pulp be 1.70. Let R be the ratio sought.

$$\text{Then } R = \frac{2.65 - 1.70}{2.65(1.70 - 1)} = 0.512$$

To determine per cent of dry slimes
Let E be per cent sought
Then $E = 66.14$
Then per cent solution $= 33.86$
The table may then be compiled as follows:

Specific Gravity of Pulp	Ratio Dry Slimes: Solution	Per Cent Dry Slimes	Per Cent Solution
1.005	1:156.30	.64	99.36
1.010	1: 61.88	1.59	98.41
1.015	1: 41.13	2.99	97.01
1.020	1: 30.75	3.15	96.85
etc.	etc.	etc.	etc.
1.70	1: 0.512	66.14	33.86
1.71	1: 0.499	66.67	33.33
etc.	etc.	etc.	etc.
2.60	1: 0.0118	98.81	1.19
2.62	1: 0.0070	99.30	0.70
2.65	1: 0.0000000	100.00	0.000000

To illustrate:

Let 500 cc. of pulp in a weighed glass cylinder weigh 1,075 grams.

Let weight of the cylinder be 225 grams.

Then the pulp weighs 850 grams, and specific gravity is 1.70.

Then R is 0.512, and per cent solution is 33.86.

Then weight of solution is 850 grams by 0.3386 or 288 grams.

Use 288 grams of water to wash pulp from the cylinder on to the filter.

Let the assay of the residue be 8.60.

Let the assay of the grinding solution be $3.46.

Let the filtrate be $5.44.

Then mill heads $= \$8.60 + 0.512(\$10.88 - \$3.46) - 54c.$ or $11.85. FRANK H. HUFF.

Kirkland Lake, Ont.

Discussion of Measures For Preventing and Fighting Fires in Metal Mine Workings

Best Protection for Shafts—Rescue of Men Is First Consideration in Event of Fire—Selection of Fan Depends Upon Local Conditions — Reversal of Air Currents a Delicate Procedure

By Charles A. Mitke
Consulting Mining Engineer, Bisbee, Ariz.

Fires are the greatest hazards in the operation of mines. The loss of life, damage to property, and disorganization which frequently accompany mine fires make them occurrences greatly to be dreaded by mining organizations. There is hardly a great mining district that has not had its big mine fires. Besides the loss of life, and the direct loss of property, there is always the indirect loss of income, both to the company and the miners, caused by shutdowns, while the fires are being put out. It has been stated by one writer that each year property worth many millions of dollars is destroyed by mine fires; yet, unfortunately, history continues to repeat itself, and ever so often we read of a fresh disaster.

The following discussion is based upon my experiences and upon conclusions drawn while present, either as an observer, or actively in charge of the work, at approximately thirty mine fires during recent years. Owing to the number and variety of these fires, an unusual opportunity was afforded to observe the advantages and disavantages of the methods in use at the present time, both in preventing fires and in handling them after they have once started.

In reviewing the situation, the question might very naturally be asked, "Are such outbreaks avoidable?" Some would appear to be preventable, though a great many might, to some extent, be charged to carelessness, and their number could probably be lessened by more thorough inspection of equipment, an efficient patrol system, and other safeguards of this nature. However, in spite of the most thorough patrol systems, it has been found that fires have started. In fact, mine fires may occur almost any time from defective electric wiring, blasting, smoking, incendiarism, spontaneous combustion, or other causes. Such fires frequently might be discovered and extinguished in the early stages, without serious consequences, provided the proper method and means of attack were thoroughly understood and at hand.

Efficient System of Fire Protection Essential

The mine is undoubtedly the greatest asset that any company possesses, as without available ore reserves, the surface equipment, such as mill and smelter, becomes useless. The successful operation of these units depends upon the furnishing of a continuous tonnage from the underground workings. Therefore, the adoption of the most efficient system of fire protection, and after fire protection the most efficient measures for fighting a fire, in the event that an outbreak actually occurs, would appear to be essential. The adoption of the most efficient system does not necessarily imply the installation of the most expensive.

A recent disaster has forcibly impressed upon everyone connected with the mining industry the necessity not only for first-class fire-protection systems, but the importance of keeping alive in the minds of an organization the rules to be followed in the event of an outbreak of fire in any part of the workings. This at once raises the question as to what constitutes a first-class fire protection system. Opinions differ in this respect. For years, papers have been published on this and allied subjects, and the problem at hand is not so much to devise new methods of preventing and fighting fires, but rather to discriminate and select those methods which will prove the most satisfactory at each particular mine; and, having once selected them, to maintain them and enforce the observance of rules connected with their use. The primary object is, of course, to prevent fires from occurring, and, secondarily, to plan an efficient method of attack in the event that a fire is started. With this object in view, numerous preventive measures are in use in different camps. Many of the features of fire protection systems which are in use at the present time are commendable, while others appear open to criticism.

Protection for Mine Shafts

Fires in timbered shafts have been in the past, and still continue to be, a menace to life and property; therefore, the fireproofing of main working shafts, which are also downcasts, should receive serious consideration.

There can be no argument as to the value of concrete as a fireproof material, but since the question of economy enters into the operation of every enterprise, the prohibitive cost makes its application necessarily limited.

Where new main operating shafts are being sunk, the concrete feature is now being seriously considered. Some of the older timbered shafts have also been concreted, but at many properties conditions do not justify the changing over from timber to concrete. The existence and use of these timbered shafts, unless protected in some manner, constitutes a fire hazard.

Concrete slabs and gunite, in upcast shafts, make good substitutes where the use of concrete is not justified. Neither of these methods, however, can be considered in the same class with the solid concrete shaft. They are, however, more economical of construction, and while not absolutely fireproof, are, of course, fire-resisting.

Where guniting or the use of concrete slabs is not feasible, provision for the rapid distribution of water over shaft timbers is desirable. Merely turning an ordinary flow of water into a shaft at the collar may not extinguish a fire, especially if it is at great depth, as the column of water may be deflected by the air currents and fail to come in direct contact with the burning timbers. A series of sprays, placed at regular intervals, distributes the water in such a manner that every portion of the shaft becomes drenched within a few minutes. A spraying system, however, is not complete, and is unsafe, unless accompanied by the use of fire doors at shaft stations. As a matter of fact, it would appear to be advisable, in the interests of safety, to install fire doors at all shaft stations where there is a possibility of a fire occurring in a shaft. Experience has shown that though a fire may possibly turn a down-

cast into an upcast shaft, the pouring of water into the shaft may have the effect of again reversing the air currents, and, if doors are not provided, forcing the smoke and gases into the workings.

Fire Doors Should Protect Shaft Stations

Properly constructed doors, when closed, minimize the air leakage, and bring the air currents practically to a standstill. Experiments made by burning fuse at shaft stations have shown that if doors at stations are comparatively air-tight, even with the fan running, the smoke moves toward the workings so slowly that the men have sufficient time to seek a safety exit. These doors can be mechanically controlled, being operated both from a valve on surface and by valves at the various shaft stations. They can also be closed individually by hand. If iron fire doors are also used at the collar of the shaft, the seal is complete, and the use of water becomes entirely effective. Reduced to a few words, this method implies elimination of air and addition of water.

Automatic sprinklers with fusible plugs, which operate automatically when the heat of the fire becomes sufficiently great to melt the plugs, have frequently been suggested for the protection of mine shafts. Their use would appear to be dangerous, especially so in shafts in which no fire doors are installed, as the sprays would begin operating at a certain temperature, and are not subject to control. This might, and probably would, change the draft and force the smoke and gas into the workings before the men had time to make their escape.

Fighting of Shaft Fires Not To Be Undertaken Until All Men Are Safe

Unnecessary as it may appear to make the statement, nevertheless it must emphatically be repeated that the fighting of a shaft fire should never be undertaken until all the men are safe. The closing of the fire doors should be done immediately, as this adds to the protection of the men, by greatly minimizing the amount of smoke and gas that might enter the workings, but absolutely no water should be turned into a shaft until the men have reached safety.

The use of fire doors, placed at important points throughout a mine, to isolate various districts, is frequently an advantage. When such doors, as well as doors at shaft stations, are closed, the rapid air currents are preventd from moving through the mine workings, and the smoke and gases may thus be held in check until the men have safely left the mine.

Refuge Chambers—Advantages and Disadvantages

Refuge chambers, which have been used to such advantage in coal mines in case of explosions, have been suggested as a safety measure, and are in use in some metal mines. These would, undoubtedly, be of advantage, providing the men were unable to leave the mine. In the case of a fire near the compressed air line, either in the shaft or on the level leading to the safety chamber, damage to the pipe might cut off the supply of air. Some writers have suggested the use of a direct churn-drill hole from surface to the safety chamber, through which air might be forced by a fan or compressor. This would, of course, be an improvement. However, it would necessitate a new churn-drill hole every time the safety chamber was moved to keep pace with the progress of stoping. Storing compressed oxygen in tanks in such chambers, together with oxygen apparatus, has also been suggested. However, if the working force is large, considerable outlay would be required to equip it with apparatus and compressed air. Moreover, unless the equipment is kept in good condition and inspected frequently, it may be found to be out of repair, or the oxygen may have been allowed to escape, and consequently the apparatus would prove useless at the critical time. Therefore, while rescue chambers undoubtedly have an advantage, it would be advisable for operators contemplating their installation to take the above considerations into account.

Selection of Reversible or Non-reversible Fans Should Depend on Local Conditions

In all large mines the control of the air currents by the use of mechanically operated fans is most important in the event of fire; otherwise the men are at the mercy of variable currents which may carry the smoke and gas in any direction and fill the entire mine. The question as to whether such fans should be of the reversible type is one which I believe should be decided, at the time of installation, by conditions at individual properties. There is no question that the use of "reversible fans" has proved beneficial in the past, and I have recommended, and shall continue to recommend, their installation in cases where it appears they can be used to advantage. However, it cannot be said that the installation of "reversible fans" applies equally to all mines, and their installation in mines in which they cannot be used to advantage constitutes a serious danger. At times of excitement, such as a mine fire, someone may hastily give an order to reverse the air currents and endanger the lives of the underground force.

Some mining men demand that an iron-clad rule be followed that all fan installations shall be of the reversible type, regardless of mine conditions, but underground conditions are entirely too variable for any hard and fast rule to be generally applicable. I know of a number of instances in which the reversing equipment, even if installed, could not be used to advantage, and would constitute a danger if it were used. The item of expense does not enter into the matter; the question is purely one of safety. To quote three typical examples of mines in which reversible equipment is not applicable:

Exhausting Carbon Dioxide Gas

In one mine the workings are approximately 1,800 ft. deep. Several million gallons of water are produced in the lower levels daily, at a temperature in the neighborhood of 130 deg. F. This water is accompanied by large volumes of gas, principally carbon dioxide, and, according to some chemists, certain quantities of carbon monoxide and arsenious gases are also produced. The ventilating system is an exhaust, consisting of three large mine fans, placed on surface, over three air shafts which extend to the lower levels and draw the steam and gases directly from the water, through unused drifts and raises, and exhaust them to surface. Were the ventilating equipment of a reversible character, and should a fire break out at any point where, under ordinary conditions, it might seem advantageous to reverse the fan, the result of such reversal would be to force the steam and deadly gases from the lower levels through all the live workings and out the present working shaft and main adit tunnel. As a consequence, one more tragedy would be added to the long list already credited to the dangerous gases in this mine.

There is also the case of a vein mine, approximately

two miles long. The ore was formerly stoped by the top-slice method, the mine being served by a long adit tunnel, running from east to west, which is the main haulageway, and by a shaft rising from the center of this tunnel to surface at the top of the mountain, a distance of 1,100 ft. The west end of the tunnel is a blind end. The tunnel is approximately the 1,100 ft. level, and the main stoping area extends from the shaft westward, a distance of 1,500 ft., and lies between the 700 and 500 levels. Above this the ground is cracked and broken to surface. Immediately over the 500-ft. level is the timbered mat of former top-slices, which have been brought down in the process of mining. The mat is approximately 35 ft. wide, 50 ft. thick, and continuous for a distance of 1,500 ft. The main adit tunnel leading to the shaft is rock, with practically no timber, while the shaft is wet from the 500-ft. level down to the tunnel.

Pressure System in a Top-Slice Mine

Several years ago, an incendiary fire broke out in an inaccessible portion of the timbered mat. It could not be reached from above, and it was impossible to flood it from below. It was, therefore, decided to allow the fire to remain, and continue stoping (using the shrinkage method) beneath. In order to obtain continuity of air currents, as the natural ventilation reversed at certain seasons of the year as well as at certain times during the day, it was decided to install a mechanical ventilating system. After due consideration, it appeared that the logical plan was to use the pressure system, installing a large pressure fan on the 700-ft. level, about 100 ft. west of the shaft, drawing air through the adit tunnel, up the shaft to the fan, and then forcing it through the stopes, fire zone, and broken ground to surface.

Since the installation of the mechanical ventilating system, the mine has been operated continuously for over two years, without a fatal accident, and without an increase in the stoping cost, other than the upkeep of the ventilating system. This fan is *not* reversible, for the reason that those responsible for the operation of the property, after due consideration, could not apprehend, under any circumstances, a contingency that would make advisable or expedient a reversal of the air currents. As a matter of fact, to prevent the natural seasonal reversal of air currents, which occurred whenever the electric power went off, resulting in a diminution or loss of pressure under the fire zone, a large connection was made to a 10-in. air line 2½ miles long. When trouble necessitated the closing down of the power plant, the employee who was in constant attendance at the mine fan would immediately close the outlet of the fan, and open the large reservoir of compressed air into the workings, so as to maintain the pressure until the power came on again. Were it possible to reverse this fan, and were that act accomplished, the results would be disastrous, as the distillation products of wood from the fire in the timbered mat would be drawn down over the men and out through the main intake.

Take the case of a low-grade copper mine, which has three concrete downcast shafts, the long main haulage tunnel from the shafts to the main stoping area being also concreted. The levels beneath are in the development stage, and may also possibly be concreted in the course of time. The electrical equipment is of the steel armored type, and is not situated in the main hoisting shafts. The mine fan is a suction, situated on the surface, over the collar of an air shaft, at the opposite end of the orebody from the working shafts, and the stopes are situated near this upcast air shaft. Every level is a definite air split, and has its own connection to the upcast shaft, through unused drifts. Nearly all the men are working either in the stopes or between the stopes and the main concrete shafts. Should a fire occur in the stopes or in the air shaft (which are the most likely places for it to occur), and the fan be reversed, the smoke and gas would naturally fill the entire mine, prevent the men from seeking safety through the several concrete shafts (which would then be upcasts), and possibly endanger the lives of the working force.

If space permitted, other examples might be quoted. With the evidence at hand, however, it would appear that no absolute rule can be made, and that the installation of "reversible" or "non-reversible" fans should always be decided by conditions at the mine to be ventilated.

Immediate Reversal of Air Currents Impracticable in Most Mines

The advantage of being able to reverse mechanically controlled air currents in the event of mine fires, particularly downcast shaft fires, is frequently advanced. It has been repeatedly stated that if the air currents had been reversed within the first few minutes many disasters might have been averted. This implies that, to be effective, the reversal should take place promptly, and brings up the question as to what may be considered "the first few minutes." Recent improvements in metal mine ventilation, and modern mining needs, which require swift ventilating currents in main shafts and on main levels, raise a doubt in the writer's mind as to whether or not we are placing entirely too much reliance on this possibility, and whether, at the average mine, and under average mine conditions, such reversal could be accomplished promptly enough to be effective.

Velocity of Ventilating Current a Factor

Practically all mining men are agreed that what the majority of metal mines need is better ventilation. Better ventilation implies larger volumes of air; larger volumes of air necessitate higher velocities; higher velocities mean much swifter currents in main shafts and through the mine workings. The possibilities resulting from the reversal, within a few minutes—say something around ten—of an air current traveling at from 100 to 300 ft. per minute, assume an entirely different aspect when the ventilating current is increased to 1,000 or 1,500 ft. per minute, and "the few minutes," adequate in the first instance, might be entirely too long to prove efficacious in the second.

Consider the question of a fire in a shaft in which the downcast air travels at the rate of 1,500 ft. per minute. The general consensus of opinion is that reversal of the air currents should not take place, except upon the orders of the superintendent, or official in charge, and that in no case should the fan be reversed without a due consideration of the consequences of such reversal.

If the fan could be reversed in time it would, undoubtedly, facilitate the escape of the men from the mine, and considerable good might be accomplished. However, it must be remembered that the reversal of the air currents, unfortunately, cannot be accomplished merely by pressing an electric button, but necessitates

the opening and closing of large, heavy doors at the fan station, which may be, and frequently is, situated on surface, in some comparatively remote section of the property. It is not unusual for such installations to be anywhere from a quarter to a half a mile from the mine office headquarters. Moreover, it is not the general custom to have a constant attendant at each fan, and therefore instructions cannot be telephoned.

Before reversal of the air currents can be accomplished, permission for such act must be obtained from someone in authority, and, as fires usually break out at unexpected moments, often at night, it may take some time to find this person. Then, again, although the fire may appear to be in the shaft, it may actually have occurred in a shaft station, or some drift leading into the shaft, and a thorough investigation must be made before reversal of the air currents is warranted.

Time Consumed in Investigation

All the above—such as a thorough investigation of the fire; reporting it to the proper authority; arriving at a decision as to whether the air currents are to be reversed; and the actual work of reversing the air currents—consumes considerable time, and could not, in the majority of cases, be done within the "first few minutes," assuming such few minutes to mean something under ten.

Suppose all this could be accomplished within ten minutes: in this period the ventilating currents carrying the smoke and gases would have traveled 15,000 ft., and, if the work took all of fifteen minutes, which it might easily do, the smoke and gases would have traveled approximately 22,500 ft., and surely would have filled the mine workings. It is a problem whether the reversal of the air currents in such a case would prove an advantage or a disadvantage. It, therefore, appears to me that the increase in the speed of ventilating currents during recent years has raised an open question as to whether or not entirely too much reliance is being placed on the reversal of air currents.

For example, take an instance quoted in a recent publication in the *Journal-Press*, discussing the question of "reversal of ventilating currents during mine fires."[1] The case referred to is that of the Granite Mountain shaft fire at the North Butte copper mine in 1917. As stated in this publication, the system of ventilation was an exhaust, two large reversible fans drawing the air from the main hoisting shaft (the Granite Mountain), and exhausting it to surface through two other shafts.

Experience in the Granite Mountain Fire

Fire was due to the "flame of a carbide lamp accidentally setting fire to the uncovered and frayed insulation of a (lead) armored power cable near the 2,400-ft. level of the Granite Mountain shaft. The highly flammable oiled fabric set fire to the shaft timbers, and the fire spread with great rapidity, soon filling the mine workings with smoke and gas. At the time 410 men were working underground."[2]

As stated in the *Journal-Press*, "immediately on learning of the fire, the general manager gave orders to have the fans reversed. The first fan was reversed within thirty minutes, and the second . . . in a little over an hour. It was later proved that at least forty lives were saved by this prompt action."

However, it is also stated in this and other publications that 161 men were killed by smoke and gas, and two burned to death, prior to the reversal of the air currents.

Every credit is due the management for saving the forty lives; the case is quoted merely to illustrate what may be expected if entire reliance is placed on reversal of air currents alone, even under ideal conditions such as those noted above, where the reversing equipment was in place and no time was lost in giving orders to put it in action.

Virtue of Automatically Controlled Fire Doors

The use of effective fire doors at shaft stations, mechanically controlled both from surface and from stations, to check the ventilating currents immediately, and which can be closed by any employee, upon discovery of fire, would appear to be a far safer method of protecting the men than merely to rely on the belief that the air currents can be reversed within a sufficiently brief space of time to prevent the smoke and gases from reaching the main workings. It is reasonable to believe that these doors can be closed within the first few minutes, and thus permit the men to seek safety at once. If the fan were also closed down, and this *can* be accomplished merely by pressing a button, it would also add to the safety of the men.

Possibility of Unauthorized Persons Reversing Air Currents

I had occasion recently to visit a certain mining district, in which a company was considering the installation of a ventilating system. The miners, excited by accounts of a recent mine fire, at which several persons from the locality had been present, were demanding that the management install a "reversible" fan, in the firm belief that, if a fire occurred, all they had to do to insure safety was to go over to the fan house (half a mile from the working shaft), and reverse the fan. Now, the question as to whether a reversible or nonreversible fan was applicable to this particular mine was not the point at issue. The serious situation was that the underground force had gained the impression that it was advisable for them to take the law into their own hands in case of an emergency, and it took considerable argument and discussion to convince the miners that the reversal of air currents is effective only under certain conditions, and, in a great many cases, might prove disastrous.

An open letter much to the same effect—viz., that, in the case of a recent disaster, the foreman or shift boss "should, without consulting anyone, have taken the shortest route to the upcast shaft, stopped the fan, and, if possible, reversed it"—has appeared in a recent issue of a well-known periodical.

In a large mine, a foreman may have charge of only one-third to a quarter of the mine workings. His knowledge is, therefore, local, and the shift boss's knowledge would be all the more so. It is doubtful, therefore, whether authority covering such an important point would be delegated to either of these men.

In this connection it should be borne in mind that in not every case is it desirable or advantageous to reverse the air currents. As a matter of fact, at the thirty mine fires referred to earlier in this discussion, in only two instances did the question "shall the fan be reversed?" arise. In all the others it was so obviously not the thing to do that the matter was not even

[1] "Reversing Ventilating Currents During Mine Fires or Explosions," M. W. von Bernewitz, *E. & M. J.-P.*, Nov. 18, 1922.
[2] "Lessons from Granite Mountain Shaft Fire," D. Harrington, Bull. 188, U. S. Bureau of Mines.

discussed. Even in the two cases mentioned, it was finally decided *not* to reverse the fan.

Advocating the installation and use of "reversible" fans, in each and every case, regardless of mine conditions, carries with it a responsibility which those making such a recommendation must recognize. Merely placing a sign at the fan stating "This fan is not to be stopped or reversed except upon authority of the man in charge of the mine" does not obviate the possibility of danger.

It behooves all operators to give this matter serious attention and, in view of the recent move toward intensive ventilation, to review all the possibilities and consequences arising from the reversal of swift air currents.

Methods of Fighting Fires in Mine Workings

Various methods of extinguishing mine fires have been employed at different mines with more or less success. The plan generally resorted to in the past has been that of sealing up the fire or fire district, and allowing it to remain for a considerable length of time, extending in some cases over a period of years, while this portion of the workings was temporarily abandoned. This has proved fairly successful in mines containing large areas of low-grade ore, but where the mine is a high-grade producer, the removal of a large portion of the orebody from active stoping, even if only temporarily, would seriously curtail production.

The method usually suggested is that of flooding. When this is used, many considerations must be taken into account. In the first place, that particular district, or part of the mine, will be idle and consequently will not be producing, and there will be no earnings from it, either for the men or the company. In the second place, a great deal of acid water may be formed, and some provision must be made to pump it out. As a rule, the pumps and all the water lines are soon damaged and there is a great difficulty in getting this acid water out of the mine. In the third place, all the drifts around stopes are frequently found to be caved after the water is drained from the fire area, and it is necessary to spile through a lot of caved ground, which may cost a great deal more than the original drifting and raising when the orebody was first opened up. Flooding is an exceedingly expensive method of extinguishing a mine fire.

Carbon dioxide has been used in extinguishing small fires. Attempts have been made to use it also at some of the large mines, but these have not all been successful, as it was not practicable to seal up those larger districts, so that the carbon dioxide could be effective.

Superheated steam is an economical method, if fuel is cheap, provided the steam can be forced into the mine close to the center of the fire district. If steam has to be forced through caved ground and the fire exists beyond the cave, its application is questionable, as the steam would condense and form water which may be deposited before it reaches the fire.

The use of sand tailings and water, forced into a fire district by compressed air, has found extensive application at some mines, and is efficacious in exceptional cases, but it also is a high-cost method of dealing with a fire.

Pressure Method of Extinguishing Fires

In attacking a mine fire by putting the district under pressure, two methods are open to choice. The first is to reverse the entire ventilating system, if it has an exhaust, and the other is to maintain the continuity of the air currents in their customary direction, and to isolate the fire district by means of bulkheads, doors, and brattices, so as to shut out air from the fire as quickly as possible, and then put the district under pressure by the use of portable blowers and ventilating pipe.

The first method has a tendency to disorganize the habits and customs of the miners, as the main traveling ways then become upcasts and are unsafe, and other and less familiar routes must be used. The second permits the work of fire fighting through the ordinary channels, such as the main working shafts, main haulageways, or other workings. This method also has the advantage of raising the pressure directly in the vicinity of the fire, and as the fans are portable, the pressure can be increased or decreased at any point when required, which is a great advantage in the efficient handling of mine fires. Furthermore, it also permits stoping operations to be carried on in the remainder of the mine in safety; whereas, if the entire ventilating system is reversed, it is doubtful whether such operations could be carried on at all. A number of operators who have used this method have satisfied themselves as to its efficiency in making a speedy attack on a mine fire and its low cost when compared to other methods of fighting fires. It is therefore suggested that, in the event of a fire, or in planning attacks on possible fires, this method be given the fullest consideration.

The Hardening of Steel

One of the most fascinating and yet obscure subjects in ferrous metallurgy concerns the problem of the hardening of steel by a suitable quenching treatment and a subsequent tempering of it by slight heating. The interest is centered around the hard constituent or structural condition, known as martensite, the name being derived from the noted German metallurgist, Martens. An investigation has recently been completed by the U. S. Bureau of Standards which has a bearing on this general subject, and Scientific Paper No. 452, entitled "Structure of Martensitic Carbon Steel and Changes in Microstructure Which Occur Upon Tempering" details the result. This paper may be secured at 15c. per copy from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Practically nothing is gained in hardness by using very high temperatures or very long heating periods prior to the quenching of steel, provided that the "critical" temperature is exceeded upon heating. The changes which take place in a hardened steel upon tempering occur in well-defined stages. Until the temperature of reheating exceeds 250 or 300 deg. C. (480 to 570 deg. F.), no marked change is to be noted in the visible microstructure, even at very high magnification, although pronounced changes in the dimensions and density often do take place even at such low temperatures. Above 250 deg. C. the separation of the carbon-bearing compound, cementite, from the martensite begins, and at 400 to 500 deg. C. (750 to 930 deg. F.) the steel shows a fine granular structure under the microscope. As the temperature of reheating is increased, the granules increase in size, although a high magnification is still required for seeing them, and the steel becomes softer and finally loses all of the high tensile properties it gained by the hardening treatment.

Improvement in Crusher Steel Is Suggested by Metallographic Tests

Examination of Failures of Mine and Mill Equipment Indicates That Sufficient Attention Is Not Given to Heat Treatment in Process of Manufacture

By Oscar E. Harder
Associate Professor of Metallography, University of Minnesota

THE DEPARTMENT OF METALLOGRAPHY of the Minnesota School of Mines has made it a practice to collect, from all sources available, parts of machinery which have failed in service, and to make a study of these parts to determine, so far as possible, the cause of the failure. This has been done with a twofold object—first, to keep informed on the subject, and to have material available for illustration in teaching metallography; and, second, to be of service to industry. In this work some of the problems have come within the field of mine-plant equipment, and the results are of sufficient interest and importance to the mining profession to justify their publication. The examples selected for this paper include the swing jaw of a jaw crusher, the shaft of a gyratory crusher, and the rim or shell of a large roll crusher. All of these had failed in service.

The investigation has been conducted to determine the suitability of these castings and forgings for the work for which they were designed, and also to determine whether, by proper heat treatment, the present material might be made satisfactory, or if it would be necessary to resort to more expensive materials, such as alloy steels.

Examination of Swing Jaw of Jaw Crusher

The crusher jaw examined was of cast steel of the following percentage composition: Carbon, 0.33; manganese, 0.59; silicon, 0.30; phosphorus, 0.047; and sulphur, 0.003. The following table shows the physical properties of fifteen specimens cut from a part of this casting after it had failed in service.

Table I.—Physical Properties of Crusher Jaw Steel

Specimen No.	Tensile Strength, Lb. per Sq.In.	Yield Point, Lb. per Sq.In.	Elongation, Per Cent	Reduction of Area Per Cent	Brinell Hardness No.
1 C	69,200		26	31	146
2 C	67,800		12	13.9	143
3 C	84,000		3	2.8	241
4 C	66,700		25	29.8	143
5 C	64,650		15	27	149
6 C	102,800		5	11	228
7 C	71,350		13.5	22.7	156
8 C	72,100		13.5	21.0	156
9 C	70,000		10.0	14.5	156
10 C	54,300		7.0	16.0	143
11 C	69,000		14	21.7	141
12 C	69,100		29	40.0	143
13 C	83,800	50,650	14.0	23.3	159
14 C	84,950	53,400	15.5	17.6	163
15 C	80,400	49,950	13.0	23.3	170

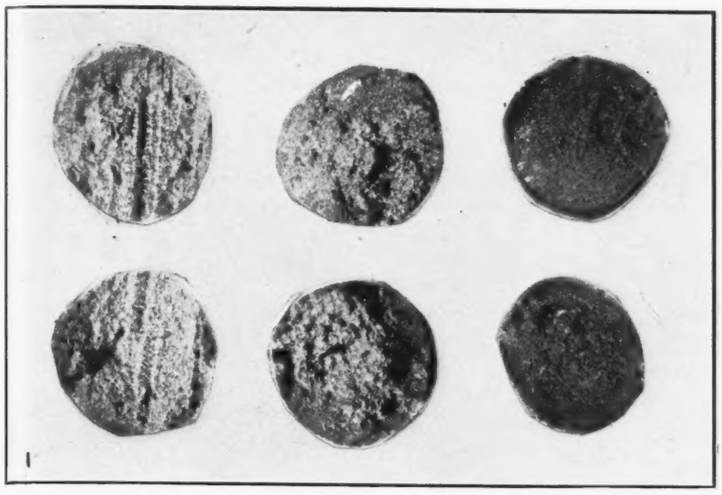
Specimens 1 C, 2 C, 4 C, and 5 C were cut from the material as received; specimens 3 C and 6 C were machined to the standard 2-in. test specimen of 0.505 in. diameter and then heat-treated in the university laboratory as follows: The specimens were heated to 830 deg. C., held for thirty minutes at that temperature, quenched in water, reheated to 565 deg. C., and cooled slowly in a hot furnace. Specimens 7 C, 8 C, and 9 C were cut from a large section, about 3 in. thick, which had been heated to about 880 deg. C., held at that temperature two hours, and then cooled in air. Specimens 10 C, 11 C, and 12 C were likewise cut from a large section, about 4 in. in all dimensions, which had been heated to 880 to 900 deg. C. for two and one-half hours and cooled slowly in the furnace. Specimens 13 C, 14 C, and 15 C were cut from a large section which had been heated to about 880 deg. C., held for two hours, quenched in water, reheated in the furnace to about 650 deg. C. for one hour, and again quenched in water.

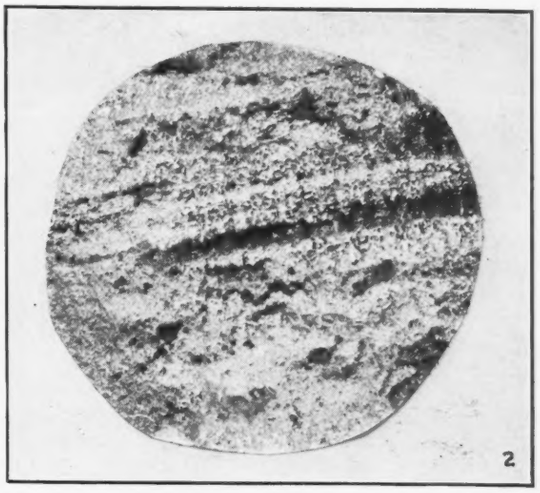
Specimens 3 C and 6 C, which were heat-treated in small cross-section, showed a marked increase in strength. No. 6 C showed an increase of about 50 per cent in strength; however, a marked falling off in the elongation and reduction of area was observed. Specimen 3 C showed a slight defect at the fracture, probably indicating unfavorable conditions in the casting, to which the comparatively lower properties were doubtless due. In general, specimens 7 C, 8 C, and 9 C, which were annealed and air cooled, showed some improvement in the tensile strength, with good properties as to elongation and reduction of area. The Brinell hardness number was somewhat higher than in the original casting. Specimens 10 C, 11 C, and 12 C showed tensile strengths (if specimen 10 C be neglected) about equal to or slightly higher than the original casting.

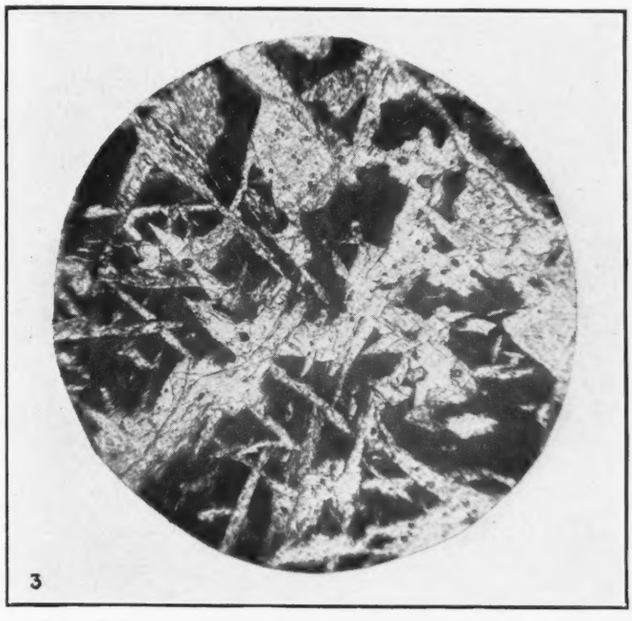
Specimen 10 C requires some special mention because it showed a large dendrite which occupied about one-third of the cross-section, and which, doubtless, caused the extremely low mechanical properties. See Figs. 1 and 2.

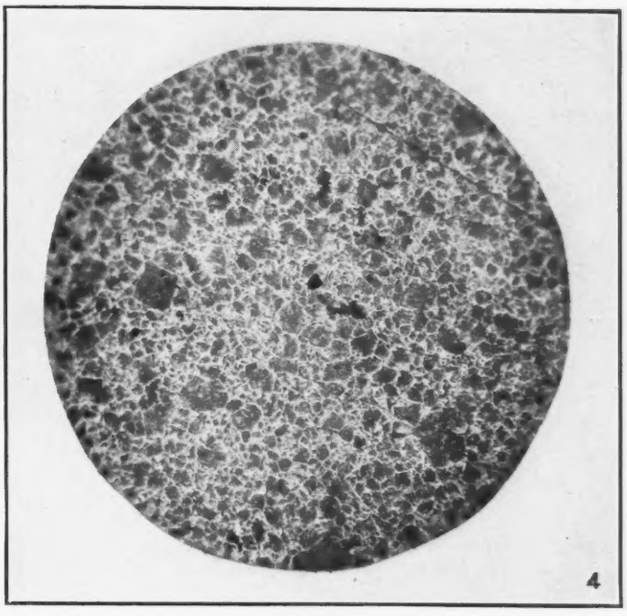
The most satisfactory properties were observed in specimens cut from large sections, about 4 in. in all dimensions, which had been heated to about 880 deg. C., held at that temperature about two hours, quenched in water, reheated to 650 deg. C., held at that temperature for one hour, and again quenched in water. The results of the tests on these specimens are shown in Table I, for specimens 13 C, 14 C, and 15 C. The tensile strengths average about 83,000 lb. per sq.in., with the yield point about 50,000 lb. per sq.in., and the toughness as indicated by the elongation and reduction of area is good. Some idea of the effect of this heat treatment may be obtained from the photomicrographs shown in Figs. 3 and 4.

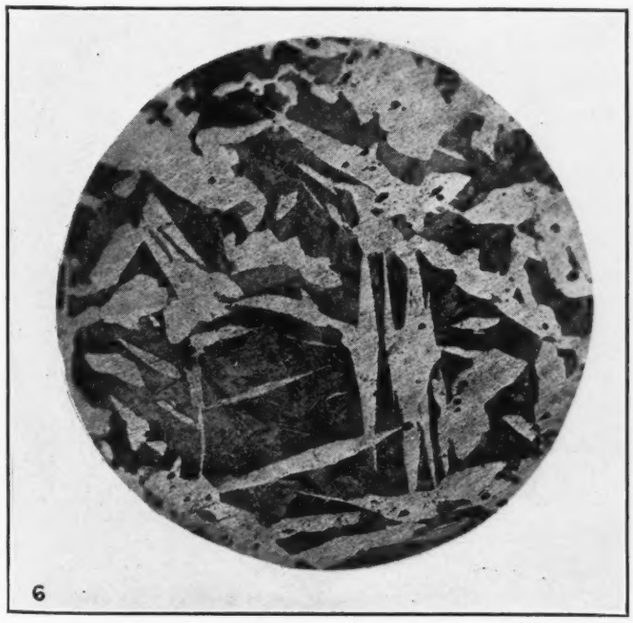
Fig. 3 shows the coarse structure found in the original material, the white areas being large masses of free ferrite (pure iron) and the dark areas being pearlitic in character. In Fig. 4, the coarse structure has been completely broken up, the grains are comparatively small, and there is a relatively small amount of free ferrite. This change in structure tells the whole story of the improvement in the physical properties. Thus, it seems that by a heat treatment such as given the pieces from which specimens 13 C, 14 C, and 15 C were cut, the original casting would have been improved in its properties. This would involve heating the casting to a comparatively high temperature, about 900 deg. C., holding at that temperature for about two hours to break up the coarse crystals formed in casting, quenching in water to prevent the re-formation of the coarse crystals, and then giving the casting a drawing treatment to soften it somewhat and develop toughness. This drawing treatment should take place at about 650











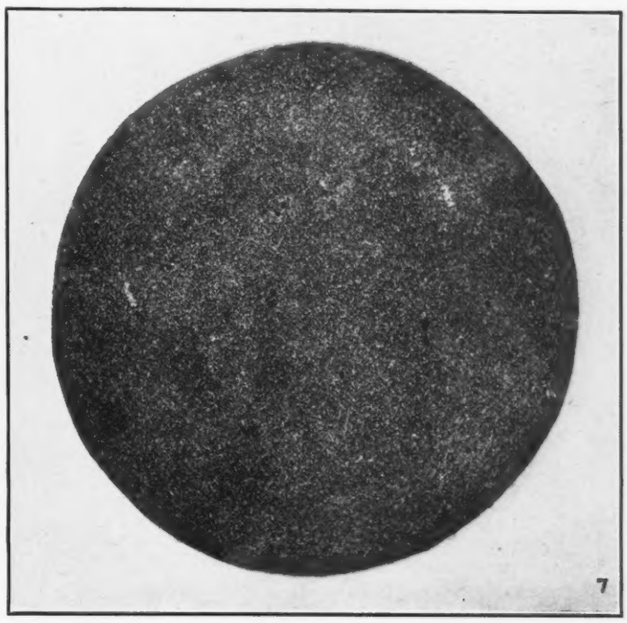


Fig. 1—Fractures on heat-treated test specimens 10 C, 11 C, and 12 C. X 2. Fig. 2—Fracture showing large dendrite. Fig. 3—Sample 4 C as received, etched with picric acid. X 30. Fig. 4—Sample 13 C after heat treatment, etched with picric acid. X 30.

Fig. 6—Sample 10 S, gyratory crusher shaft as received, etched with picric acid. X 100. Fig. 7—Sample 15 S, after heat treatment, etched with picric acid. X 100. *See p. 317 for Fig. 5 showing standard Charpy impact test specimen.*

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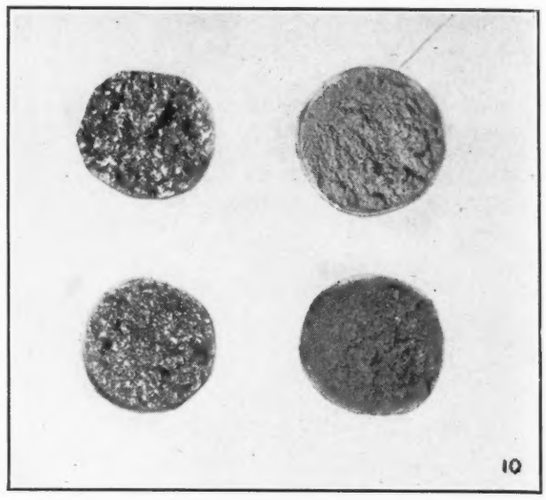

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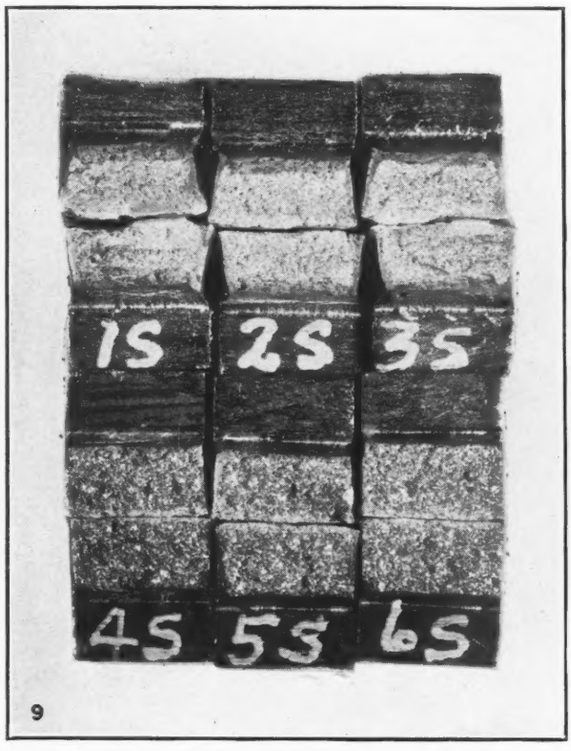

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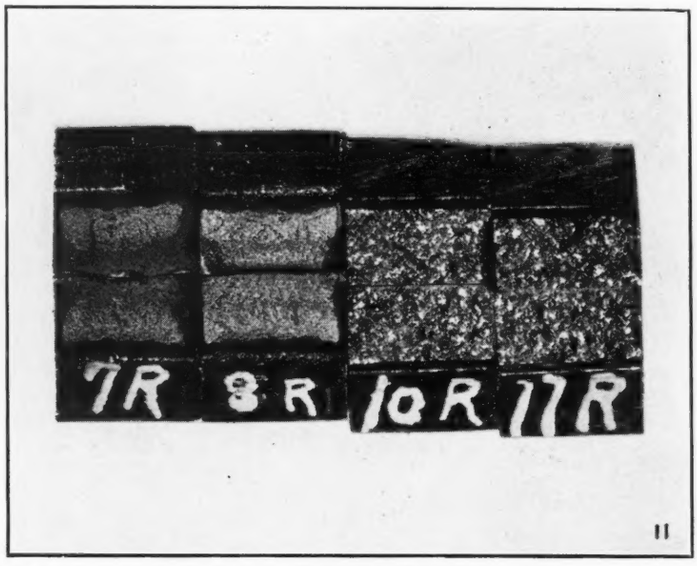

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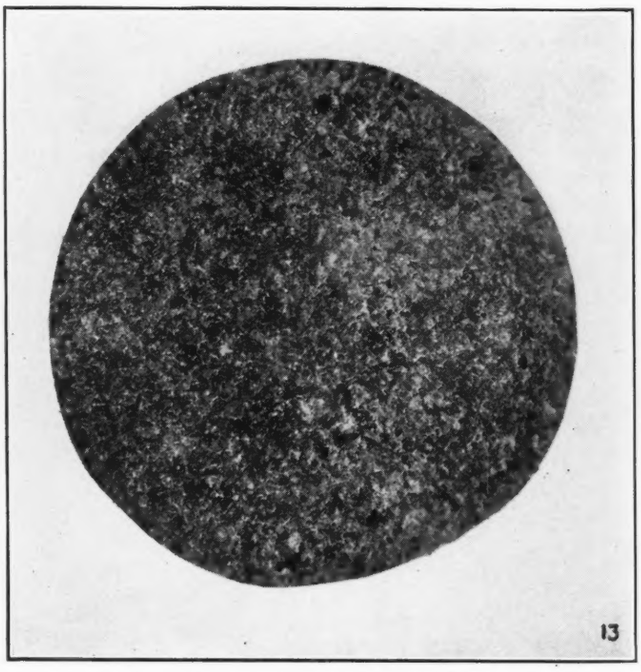

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Fig. 8—Fractures of tensile test specimen from gyratory crusher shaft. Left, 10 S, as received. Center, 12 S, "woody" structure. Right, 15 S, good fracture on heat-treated sample. Fig. 9—Fracture of impact bar from gyratory crusher shaft. 4 S, 5 S, 6 S, as received. 1 S, 2 S, 3 S, after heat treatment. X 2. Fig. 10—Fractures of tensile test specimens from roll crusher rim. Left, 20 R, and 23 R, as received. Right, 21 R and 2½ R, after treatment. X 1.7. Fig. 11—Fractures of impact bars from roll crusher rim. 10 R and 11 R, as received. 7 R and 8 R, after treatment. X 2. Fig. 12—Micrograph of roll crusher rim as received. Specimen (20 R) etched with picric acid. X 75. Fig. 13—Micrograph after treatment. Specimen (22 R) etched with picric acid. X 75.

to 700 deg. C., and should last from one hour to two hours after the specimen comes to that temperature.

The chemical analysis of a section of a gyratory crusher shaft that had failed in service was as follows, in per cent: C, 0.51; Mn, 0.61; Si, 0.25; P, 0.011; and S, 0.034. In Table II, the physical properties of this material, as received, are shown by specimens 10 S, 11 S, and 13 S. Specimens 12 S and 15 S were quenched in oil from 825 deg. C. and drawn at 625 deg. C. for one hour, being cooled in the furnace from the drawing temperature. Specimen 14 S was drawn similarly to 12 S and 15 S, but was not previously hardened by quenching.

Table II—Physical Properties of Gyratory Crusher Shaft Steel

Specimen No.	Tensile Strength, Lb. per Sq.In.	Elongation, Per Cent	Reduction of Area Per Cent	Brinell Hardness No.
10 S	70,400	8.0	6.2	156
11 S	66,600	5.0	4.2	143
12 S	94,700	11.0	13.9	212
13 S	76,950	12.0	19.5	163
14 S	71,750	24.0	39.0	170
15 S	95,500	21.0	59.2	207

Sample 15 S shows an increase in tensile strength of about 30 per cent over the material as received. Sample 12 S shows a fairly good increase in tensile strength, but with somewhat lower values of elongation and reduction of area, doubtless owing to what is known as a woody structure (Fig. 8), which this particular specimen exhibited. The Brinell hardness numbers of specimens 12 S and 15 S are slightly increased, but the elongation and reduction of area on specimen 15 S indicates that no loss of ductility or toughness occurs in this heat-treating operation.

Impact Toughness Determined

Specimens were machined from this shaft and tested by impact, following the regulations of the standard Charpy impact test specimen (Fig. 5). Three specimens were tested, representing the original material,

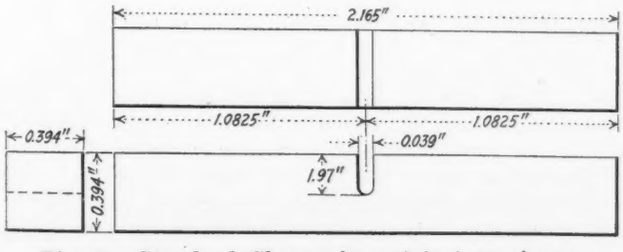


Fig. 5.—Standard Charpy impact test specimen. Notched bar for transverse test

and three were heat-treated by heating to 825 deg. C., quenching in oil, drawing at 625 deg. C. for one hour, and quenching in water. The average impact value of the original material was found to be 10 ft.-lb., whereas the heat-treated material had an average impact value of 32 ft.-lb. In other words, by this heat treatment the impact toughness had been increased more than 200 per cent. The average Brinell hardness of the three heat-treated was 168, compared with 138 for the original material. This heat treatment was the same as that used on specimen 15 S, already mentioned; to summarize, it increases the tensile strength about 30 per cent, gives good ductility, as shown by the elongation and reduction of area, and increases the impact toughness by more than 200 per cent. The average Brinell hardness of the heat-treated specimen is somewhat higher than that of the original material, so that, without loss of ductility or toughness, the heat-treated steel would have somewhat better wearing properties.

An understanding of what has been accomplished by the heat treatment to which the specimens were subjected is best obtained by the examination of the micrographs shown in Figs. 6 and 7 and the fractures shown in Figs. 8 and 9.

Fig. 6 shows the structure of this shaft as received at the laboratory. The coarseness of the structure is evident, and the large white areas represent the excess of free ferrite which is always associated with comparatively poor physical properties. The coarse grain might be due to the original coarse structure formed in the casting of the ingot, to exceedingly high temperatures used in the forging operation, or to a combination of these two effects.

Fig. 7 shows that this structure can be completely broken up by heat-treating. Similar contrasts are found by the examination of 10 S (left) and 15 S (right) in Fig. 8. 10 S is the original material and shows a coarse shiny fracture, whereas 15 S is the heat-treated material with high tensile strength, good reduction of area and elongation, and a fine cupped fracture in the tensile specimen. Likewise, a similar contrast is found by the examination of the structure of the impact fracture shown in Fig. 9.

Specimen 12 S (center) in Fig. 8, shows what is known as the "woody" fracture, which reflects considerably on the quality of this steel. In Fig. 7 also there is some indication of impurities.

Finally, this steel is obviously of poor structure, due to improper handling or lack of suitable heat treatment; and there is also warrant for assuming that it is of inferior quality, as indicated by a rather large amount of impurities, and the fracture on some of the specimens.

After the shell from a roll crusher had failed in service, a section was taken adjacent to the fracture and used in this investigation. The percentage composition of this shell was C, 0.82; Mn, 1.01; Si, 0.24; P, 0.018; and S, 0.013. The following table shows the physical properties of this steel as received, and after two different heat treatments.

Table III.—Physical Properties of Roll Shell Steel

Specimen No.	Tensile Strength, Lb. per Sq.In.	Elongation, Per Cent	Reduction of Area, Per Cent	Brinell Hardness No.
20 R	99,000	9	9	212
21 R	160,750	0	0	512
22 R	135,500	11	25.8	282
23 R	103,000	17	18.3	207
24 R	154,500	0	0	555
25 R	134,900	8	9.5	286

Specimens 20 R and 23 R (Fig. 10, left) represent the original material. Specimens 21 R and 24 R (Fig. 10, right) represent material given a double heat treatment by quenching from 825 deg. C. in oil, followed by another quench from 775 deg. C., with a draw at about 300 deg. C. The tensile strength was increased somewhat over 50 per cent (an average of 56 per cent) by this heat treatment. The Brinell hardness number also was increased over 100 per cent. The refinement of the grain is shown by comparison of the fractures in Fig. 10.

However, this heat treatment reduced the elongation and reduction of area practically to zero, which presumably is too hard and brittle a material for this particular service. Specimens 22 R and 23 R were given the same double quench as 21 R and 24 R, but were drawn one hour at 600 deg. C. These specimens showed an increase in tensile strength of about 35 per cent, and

yet they exhibit good toughness as indicated by the elongation and reduction of area. They still had about 40 per cent greater Brinell hardness than the original material.

Because of the unusually coarse structure observed in this steel, it was thought likely that the impact value would be exceedingly low. Accordingly, impact specimens were obtained and tested, with conclusive results. The average of two specimens from the original material showed an impact value of only 2 ft.-lb. on standard Charpy bars. The impact tests of specimens given the heat treatment already mentioned, quenching from 825 deg. C., again from 775 deg. C., and followed by a draw at 600 deg. C., showed an average impact value of 13.25 ft.-lb. Although this is not a high impact value, and doubtless a slightly higher draw would have improved the impact properties, it is a pronounced improvement—about 500 per cent—over the original material. Likewise, the Brinell hardness was improved with the improvement in toughness, so that the Brinell hardness number changed from about 190 to about 270, which, presumably, would be a favorable change. The indications were that this steel as received had been heated to such a high temperature that the grain had been much coarsened, the tensile strength reduced, and the impact toughness made exceedingly low. All of these properties could be improved by some such heat treatment as has been indicated.

The explanation of the improvement in properties by heat treatment is found in the examination of the fractures and micrographs of the material before and after heat treating. Fig. 10 shows the fractures obtained on tensile test specimens before and after heat treating. Specimens 20 and 23 (left), which are the original material, show coarse grain and shiny fracture. A similar relation is found in fractures of the impact specimens shown in Fig. 11. Any one familiar with the fracture of steel will recognize the poor structure.

Further information is obtained by examination of the micrographs shown in Figs. 12 and 13. At the low magnification of X75 the original material shows a coarse grain, which is dimly outlined in this micrograph. The micrograph in Fig. 13 is of the same magnification, and the grain is much smaller and of uniform size.

The heat treatment indicated in these experiments and applied to small specimens would not be exactly right for large cross-sections; but, doubtless, it is possible by a heat treatment similar to the one indicated, followed by a high draw, to give higher tensile strength, much greater toughness, increased hardness, and to produce a steel which should give much better service where resistance to abrasion is one of the requirements.

From the examinations reported, it appears that the pieces of mine-plant equipment upon which the tests were conducted had not received the best heat treatment in their fabrication. Although the composition of the material may not have been ideal, the properties are far from being as good as they might have been under conditions of proper treatment.

The crusher jaw may be considerably improved by a simple heat treatment. Thus, heating to a temperature of about 900 deg. C., holding at that temperature for about two hours, quenching in water, followed by a draw at a temperature of 650 to 700 deg. C. for one to two hours, will break up the coarse structure produced in the casting, refine the grain, increase the tensile strength without loss of toughness as indicated by reduction of area and elongation, and give the material a slight increase in hardness. In quenching operations as outlined, it is better practice to remove the casting from the quenching bath before the steel is entirely cold, thereby lessening the danger of cracking during quenching.

Considering the gyratory crusher shaft, there is some indication that the steel is not of the best quality and, beyond doubt, the structure is exceedingly poor. It has been shown that by a single heating, followed by a quenching operation and then a draw to produce the proper toughness, the properties of this material can be greatly improved. Here again it is better to remove the steel from the quenching bath while it is still hot, say 200 to 300 deg. C.

In the service required of this shaft probably the most important property to be considered is the impact value. The heat treatment mentioned increased the impact value 200 per cent, and, doubtless, such heat treatment would greatly improve the service to be obtained from this shaft. There is entire agreement in the improvement of the physical properties, the modification of the character of the fracture obtained, and the results obtained by examination of the micrographs.

In the roll crusher shell, an unusually coarse structure was observed in the original material, and this was accompanied by exceedingly poor impact properties. Here the increase in the impact properties obtained by the heat treatment described is about 500 per cent. The unusually low impact properties in the original material would have enabled one to predict before the piece went into service that it would fail, and had the fabrication of this part been accompanied by some metallographic examination that would have shown the structure, it doubtless would not have been put into service without heat treatment. Even without using such complicated heat treatment as has been discussed in this report, some improvement could have been derived from a simple annealing—i. e., heating above the critical range, holding at that temperature long enough to refine the grain and to produce uniformity of structure, and then cooling in air.

Alloy steels make it possible to decrease the weight of equipment and retain a given strength, or, with a given weight, to increase the strength of the equipment. It is not possible in this particular investigation to say whether or not it would have been necessary to use alloy steels. That would have required a knowledge of the working stresses for all of the parts. As an illustration, the elastic limit on a straight carbon steel may be 75,000 lb. per sq.in., whereas an alloy steel may have an elastic limit of 150,000 lb. per sq.in. This would indicate that for a given stress the alloy steel would have a much greater factor of safety, or, in other words, with a given factor of safety an alloy steel can be worked under a much greater stress. The investigation indicated that the properties of the three pieces of mining plant equipment examined were far from being as good as they might have been under proper methods of production, and it may be that satisfactory parts can be obtained without the use of alloy steels, which are always somewhat more expensive in original cost.

Finally, from the results of the examinations here recorded, I believe that much good can be accomplished by an application of the principles of metallography to the examination of parts that have failed in service, with a view to improving the processes used in their production, frequently without increasing the cost.

Barytes: Occurrence, Mining, Uses

Mineralogical Characteristics—Typical Deposits—Geographical Distribution of World's Supply—Statistics of Production and Consumption—Methods of Mining and Washing — Lithopone Industry the Largest User of Barytes — Applications of Ground Barytes—Chemical Manufactures

BY RAYMOND B. LADOO*

Raymond B. Ladoo

BARYTES, barite and heavy spar are different names for the same mineral. When pure it is composed of barium sulphate ($BaSO_4$) of which 65.7 per cent is barium oxide (BaO). Barytes is a heavy mineral, occurring most commonly in light-colored granular or crystalline masses or in nodules. It also occurs in tabular crystals of the orthorhombic system. The following physical properties help to identify the mineral: Hardness, 2.5 to 3.5; specific gravity, 4.3 to 4.6; melting point, infusible, but changes to BaO with high heat; index of refraction, 1.636 to 1.648; color, white to light shades of gray, blue, yellow, brown, or red; streak, white; luster, vitreous to almost resinous, or pearly; when granular almost earthy; cleavage, two perfect at right angles, third indistinct; transparency, transparent to opaque; tenacity, brittle.

WIDE GEOGRAPHICAL DISTRIBUTION; MINED IN ONLY A FEW COUNTRIES OUTSIDE OF THE UNITED STATES

Geologically, barytes occurs in veins or masses in limestone, as nodules in clay, and as a gangue mineral in veins or beds with fluorspar and ores of lead, zinc, iron, and copper. Geographically, barytes is well distributed throughout the world, but it has been mined only in countries which are well developed industrially, as its value has not been large enough to encourage exploitation in remote regions.

In the United States, Georgia is the leading producer. Practically all the production comes from the Cartersville district, in Bartow County. Residual nodules in clay are mined by steam shovel, principally for use in the lithopone and barium chemical industries. Since 1915, Georgia has contributed about 50 per cent of the total domestic production. Most of the Georgia ore is of the hard, crystalline variety.

Missouri is second in importance. The most important district is in Washington County, but a steady production comes from the central district. Here small, scattered residual deposits are worked by hand, largely for the ground barytes industry. Before 1915, Missouri produced about 65 per cent of the total United States output. Most of the Missouri ore is of the soft variety.

The Tennessee production comes mostly from the Sweetwater district, but some is produced in the Del Rio district. Both the hard and the soft ores are found in Tennessee. Kentucky barytes mines are situated in Fayette, Boyle, Garrard, Mercer and Woodford counties. The following states have produced barytes: South Carolina, Alabama, Virginia, North Carolina, and Nevada.

GERMAN DEPOSITS ARE RICH

Before the war Germany was the largest producer of barytes and barium chemicals and practically dominated the world markets. The German deposits, which are in vein formation, are large, exceptionally pure, and easily mined. The best deposits are in the Harz Mountains and Thuringenwald. Witherite (barium carbonate) is also mined in the latter locality. Lower-grade barytes is mined in the Rhine district.

Barytes and witherite, in commercial deposits, are both fairly abundant in Great Britain and Ireland, but for many years prior to the war production was not large, as the cheap German barytes and barium chemicals dominated the markets. Gradually, however, production increased, until during the war it rose to the point where home production supplied practically all needs. During the war England imported only a small amount of barytes, but in 1919 her imports were over 20,000 tons, chiefly from Spain and the United States.

The principal barytes deposits in Canada are at Lake Ainslie, Cape Breton Island, and North Cheticamp, Inverness County, Nova Scotia; and the only regular production comes from the former locality. In recent years attention has been drawn to extensive deposits in northern Ontario, particularly in Langmuir Township, in the Porcupine district. Practically all of the Canadian deposits are of the vein type.

Deposits of barytes occur in Italy at Albenga, near Valsassina and in Sardinia. France has large resources of pure white barytes, easily and cheaply minable. The principal deposits are at Avéne, in Herault, near La Creuse, and at St. Céré, in Lot, near Bretenoux. Barytes is mined in Spain in the province of Navarra, in the northeastern portion of the country, adjoining the Pyrenees, but deposits are also worked in the provinces of Gerona, Tarragona, and Almeria, generally associated with lead ore. In South Australia the principal production comes from near Noarlunga, about 25 miles from Adelaide.

Before the war barytes was a relatively low-priced commodity, and Germany, with her abundance of high-grade material and cheap labor, practically dominated the world markets. This situation made impracticable

*This article is one of a series on various non-metallic minerals that is being written by Mr. Ladoo. Later he intends to expand each article somewhat to form a chapter in a book on the non-metallic mineral industries. The *Journal-Press* accordingly is assigning the copyright to Mr. Ladoo, and he reserves privileges of reprinting in whole or in part.

the development of good deposits in many parts of the world. When the war came, prices rose rapidly, and the production centers shifted, and it is now doubtful as to whether or not the pre-war situation will be resumed.

World Production of Barium Minerals

In Metric Tons

	1913	1914	1916	1917	1918	1919	1920
United States	41,085	146,753	201,301	187,647	140,919	189,939	206,990
Germany (*a*)	.....	.....	.....	.....	.....	.....	.....
Bavaria	27,199	18,023	12,487	10,000	5,510	8,804	.....
Baden	16,445	(*b*)	(*b*)	(*b*)	(*b*)	(*b*)	(*b*)
United Kingdom	50,861	49,728	77,274	66,625	67,442	21,067	.....
Italy	12,970	12,970	21,650	19,000	12,300	15,917	.....
France	12,236	(*b*)	(*b*)	(*b*)	(*b*)	(*b*)	(*b*)
Spain	3,049	2,474	10,508	10,147	4,160	11,459	.....
Australia	552	739	1,244	1,276	2,071	2,829	.....
India	.....	.....	.....	.....	2,768	2,632	.....

(*a*) Total for Germany unavailable. German exports of barytes in 1913 were about 158,065 metric tons; pre-war output said to be about 270,000 metric tons per year.

(*b*) Figures unavailable.

Apparent Domestic Consumption of Crude Barytes (*a*)

In Short Tons

Year	Sales of Domestic Barytes	Imports for Consumption	Apparent Consumption
1914	52,747	24,423	77,170
1915	108,547	2,504	111,051
1916	221,952	17	221,969
1917	206,888	6	206,894
1918	155,368	.....	155,368
1919	209,330	118	209,448
1920	228,113	24,874	252,987

(*a*) U. S. Geological Survey.

and the remainder in chemical plants in Tennessee and West Virginia and in ground barytes plants in Georgia, Kentucky, Virginia, and South Carolina, and in a lithopone plant in Maryland. Some lithopone and barium chemicals are now manufactured in California.

In the two largest producing states, Georgia and

Mining barytes by steam shovel at the Paga company's mine at Cartersville, Ga.

The accompanying incomplete statistics show only partly the changes in producing centers.

In 1919, about 40 per cent of the barytes used for barium products was consumed in the Philadelphia district (in New Jersey, Pennsylvania, New York, and Delaware), about 40 per cent in the St. Louis district, Missouri, barytes occurs as nodules in clay; but in Georgia the deposits are relatively large and uniform, enabling large-scale operation, frequently with steam shovels, whereas in Missouri the ore is more scattered, and small-scale operations with hand labor are necessary. As the production of vein barytes in the United

Production of Barytes by States

State	1917 Quantity Short Tons	1917 Value	1918 Quantity Short Tons	1918 Value	1919 Quantity Short Tons	1919 Value	1920 Quantity Short Tons	1920 Value
Alabama	1,976	$8,868	1,794	$9,976	(*a*)	(*a*)	(*a*)	(*a*)
Georgia	111,300	601,895	69,318	418,178	86,303	$667,521	84,644	$790,362
Kentucky	6,720	36,084	(*a*)	(*a*)	5,435	36,408	(*a*)	(*a*)
Missouri	59,046	391,363	49,094	393,738	73,247	640,398	99,654	1,013,570
North Carolina	1,019	5,080	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)	(*a*)
Tennessee	16,972	79,058	22,542	141,844	34,700	288,622	29,319	213,657
Other States (*b*)	9,855	48,836	12,620	81,169	10,645	94,873	14,496	124,875
	206,888	$1,171,184	155,368	$1,044,905	209,330	$1,727,822	228,113	$2,142,464

(*a*) Included in other states.

(*b*) Includes 1917: California, Nevada, South Carolina and Virginia.
1918: Kentucky, Nevada, New Mexico, North Carolina, South Carolina, Virginia and Wisconsin.
1919: Alabama, California, Illinois, Nevada, North Carolina, South Carolina, Virginia and Wisconsin.
1920: Same states as in 1919 with Kentucky in addition. (California production was 2,250 tons, valued at $20,850.)

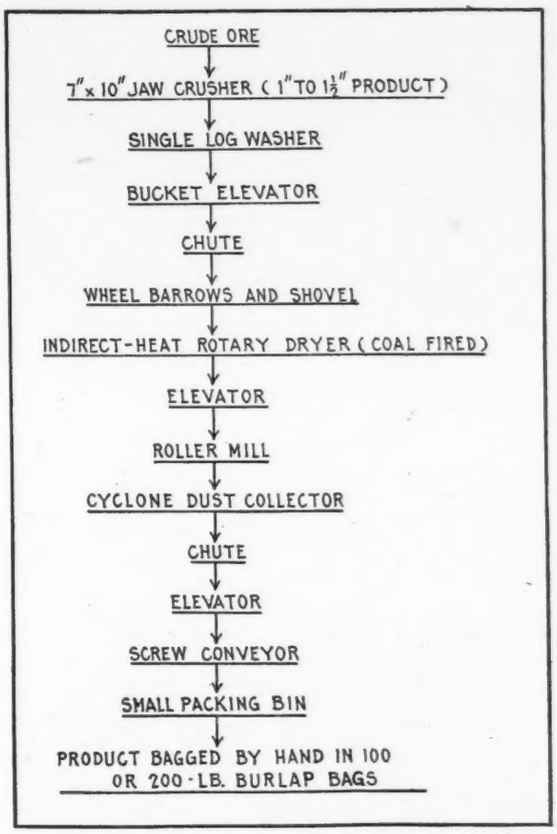
States is comparatively small, the methods of mining will not be described.

In Georgia, the barytes occurs in nodules as residual concentrations from veins and replacements, largely in tilted beds of limestone. In prospecting, ore fragments are sought in red clayey soil on a hillside down the slope from an outcrop of ferruginous chert or quartzite. Circular test pits about 30 in. in diameter and 10 to 40 ft. in depth are sunk by hand to determine the existence of ore, the thickness of overburden, and the thickness of the deposit. Overburden varies from a few inches up to 30 ft. or more. Ore varies in barytes content from 5 to 40 per cent or over, but 5 per cent is now about the low limit for profitable operation. When a workable deposit of at least 5,000 tons of washed ore is blocked out, the ore is shot down, loaded by ¾- to ⅞-yd. steam shovels into small quarry cars, and hauled to the washer. Often deposits are connected by narrow stringers through which the shovel can follow the ore. The overburden usually carries some barytes, and if rich enough it is shot down and loaded with the ore, as it is cheaper to wash out the dirt than to strip the deposit.

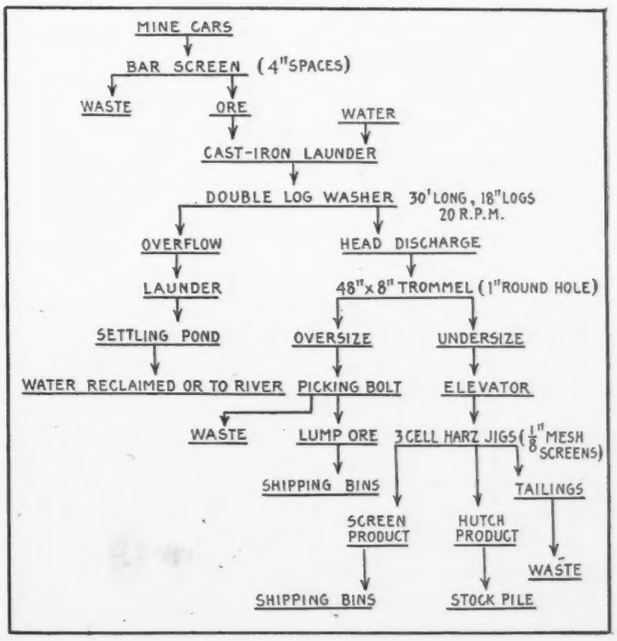
At the washer the ore is treated to separate the barytes from the clay and sand, the sequence of operations being indicated in the accompanying flow sheet.

The hutch product, averaging 50 to 70 per cent barytes, is sometimes ground and shipped as a low-grade, off-color product, but usually in the past it has been wasted. Plans are now under way to re-work hutch product dumps on Overstrom tables to save fine mineral.

From the washers the ore is either shipped direct to lithopone and barium chemical plants or by car or rope tramway to grinding mills.



Flow sheet of mill for grinding barytes in Georgia



Flow sheet of a typical barytes washing plant in Georgia

In England much of the barytes is obtained by the underground mining of veins which may contain either barytes alone or barytes associated with galena. A system of shrinkage stoping over timbers is commonly used.

In Missouri the barytes occurs as nodules in more or less horizontal beds of residual clay, and, as the distribution is not uniform, all of the workings are small, shallow pits scattered over a wide area. The major part of the barite is obtained at an average depth of about 4 or 5 ft. Holes more than 10 or 12 ft. deep are rare, although a few go down as far as 18 or 20 ft. Sorting is sometimes done in the pit, but generally all of the material is removed.

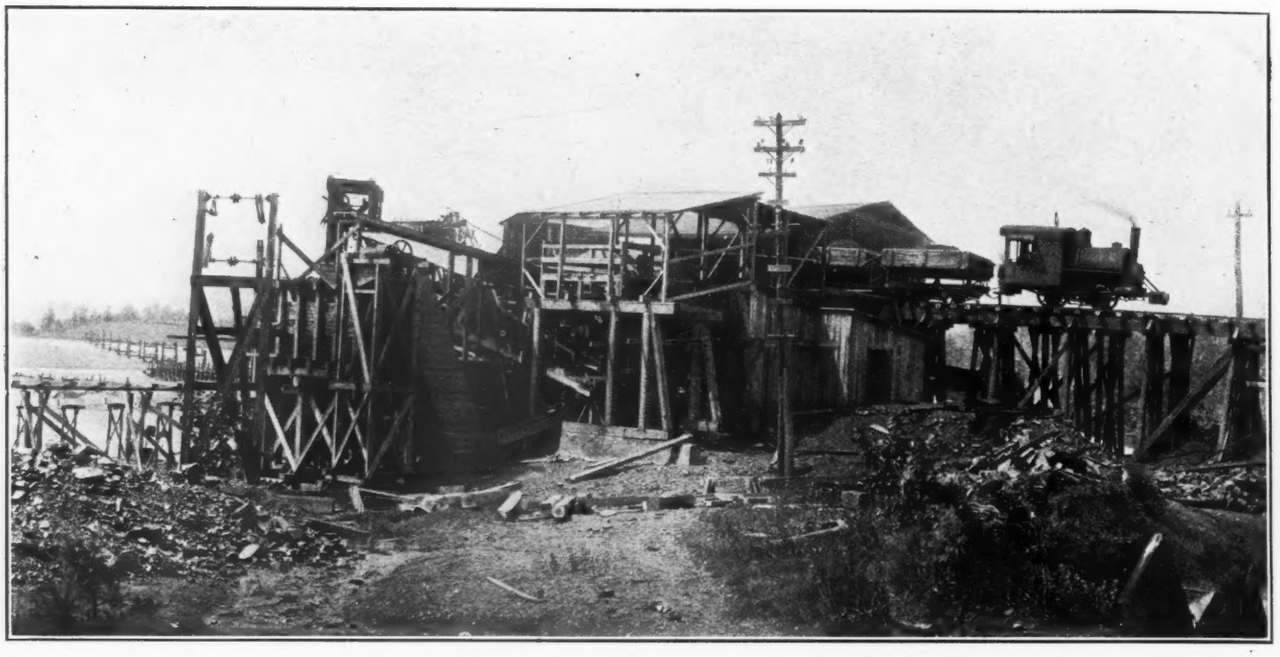
The ore is usually dried in the sun, and the chunks of barytes are cleaned of clay and sand by shaking in a wooden box with a perforated bottom. Further purification of the ore is not done in the field, but at the grinding plants. At one plant the crude ore is crushed to one inch and then passed through an automatic washer (log washer type) to remove the clay.

Barytes may be shipped crude to plants manufacturing lithopone or barium chemicals or to mills which manufacture ground barytes. As only in the latter process is the final product still the mineral barytes, the other processes will be considered under utilization.

Most of the barytes mined is so stained with iron oxide and other impurities that a pure white ground product cannot be made without bleaching. There is a limited market for off-color ground barytes, and some crude unbleached ore is ground. The illustration in the opposite column is a flow sheet of a mill in Georgia grinding off-color ore by a dry-grinding process.

The flow sheet on page 323 shows how the ground material is bleached with sulphuric acid in Missouri.

Steam is added in the bleaching tanks, both to heat and to agitate the heavy sludge. A temperature of about 212 deg. F. is maintained in some plants. The bleaching usually requires eight to twelve hours. In England, the bleaching solution is usually one part acid to three parts of water. Here the fine grinding is com-



Paga Mining Co's. washer near Cartersville, Ga.

monly done by passing the wet pulp through French buhr stone mills at least twice, and drying is done on flagstones set over flues. In the German practice, a much finer product has been obtained by passing the pulp through as many as eleven buhr mills in series. If the ground product is not sufficiently white the color is "killed" by the addition of small quantities of ultramarine blue, usually during the grinding.

Crude barytes is sold on the short ton basis, f.o.b. cars at the mines, and may be shipped either in box cars or open-top cars. In Missouri, most of the production is first sold in small lots to brokers and by them sold and shipped to the consumers. In Georgia many of the mines are owned by the large manufacturers of lithopone and barium chemicals. Ground barytes is usually shipped in bags or barrels and is sold at a price on a short ton basis, f.o.b. railroad cars, shipping point.

Prices on blanc fixe and barium chloride are quoted per short ton, usually at the New York or St. Louis markets, and the products are shipped in bags or barrels. Lithopone and the other barium chemicals are usually quoted in cents per pound at the principal markets, in bags or barrels.

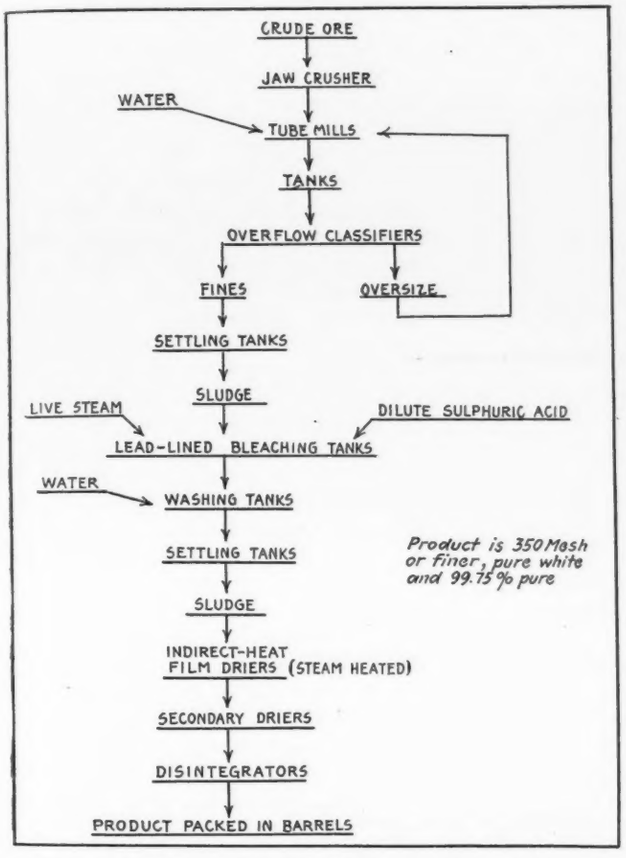
Specifications Are Not Standardized

No standard specifications or tests for either crude or ground barytes are now observed. In the trade, two general types of crude ore are recognized: the "soft" ore and the "hard crystalline" ore. The soft ore can be easily crumbled and is preferred by the grinders, as it is more easily ground and bleached. It is also said to roast better. The hard crystalline ores can be used to

New washing plant of the Bertha Mineral Co. at Cartersville, Ga.

better advantage in the lithopone and barium chemical industries. Commercial crude barytes should contain not less than 93 per cent $BaSO_4$; the better grades contain 95 to 98 per cent $BaSO_4$ and 1 to 3 per cent of silica.

Ground barytes is marketed in several grades, dependent on color and fineness, from the coarse ground off-color products to the very fine ground, pure white,



Flow sheet of mill for grinding barytes in Missouri

water-floated product. When used as a filler for paper or rubber it must be at least 200 mesh and is often 350 mesh—the finer the better. For the paint trade a pure white product is needed, but extreme fineness is not always desired; in fact, extremely fine-ground barytes is said to be unsuitable for some paint purposes.

For the manufacture of lithopone and barium chemicals soft, bleached barytes has been preferred in the past, but now the hard crystalline, iron-stained product is used extensively. Low silica and low iron-oxide content is desired, and maximum permissible amounts of these impurities are usually specified in contracts. The uses for barytes may be divided broadly into three groups; (a) ground barytes, (b) lithopone, and (c) barium chemicals. The distribution of barytes consumption into these groups, according to reports from manufacturers, is as follows:

Consumption of Crude Barytes[a]

In Short Tons

Year	Ground Barytes	Lithopone	Barium Chemicals	Total
1917	60,132	86,065	49,842	196,039
1918	62,440	85,282	38,041	185,763
1919	64,922	103,688	32,976	201,586
1920	79,052	113,181	37,210	229,443

(a) Compiled from reports made by the manufacturers of barium products.

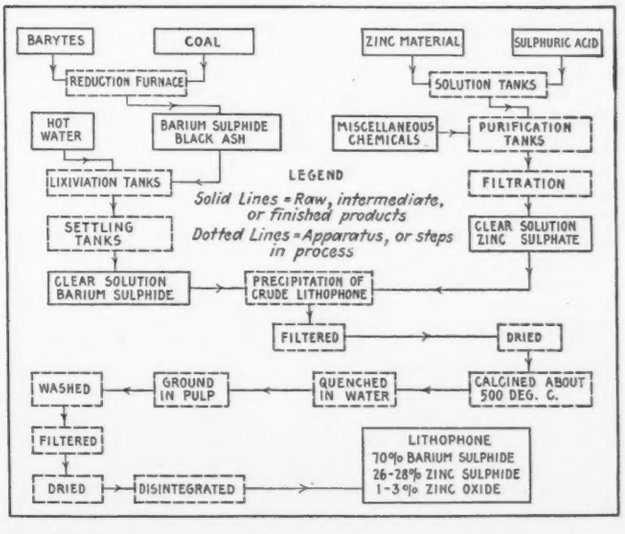
Ground Barytes is used chiefly as an inert mineral filler in paper, rubber, cloth, linoleum, oilcloth, and similar products, and as a constituent of paint, both as a white pigment and as an inert extender. It is especially useful as a filler and surfacing material for playing cards, enameled paper, and oilcloth, where a highly calendered surface is desired. It is also used as a filler in making artificial ivory and buttons; as a base for the precipitation of lake colors; in ceramic glazes and enamels; as a constituent of some types of glass; and as an inert filler and body material for many miscellaneous products where a heavy, crystalline filler is desired.

Barium Sulphate and Zinc Sulphide Make Lithopone

Lithopone, also known by the trade names Ponolith, Beckton White, Marbon White, Zincolith, Sterling White, B-J White, Grasselli White, and other designations, is a white pigment consisting approximately of 70 per cent barium sulphate and 30 per cent of zinc calculated as zinc sulphide. The zinc sulphide is usually replaced by 1 to 3 per cent of zinc oxide. The European brands contain zinc sulphide in amounts varying from 11 to 42 per cent. The commercial product is a fine-grained white powder, 98 to 99 per cent of which will pass through a 300 mesh screen. The accompanying chart[1] shows briefly the method of lithopone manufacture.

One of the most important steps in the process is the purification of the zinc-sulphate solution, for to produce a pure-white product an almost chemically pure zinc-sulphate solution must be used. This process is usually kept secret, but in general it consists of using a powerful oxidizing agent to precipitate iron and other metallic sulphates, filtering, boiling with zinc dust to remove cadmium and cobalt, and refiltering.

To manufacture a ton of lithopone, over one and one-quarter tons of barytes and a total of about four tons



Diagrammatic outline of lithopone manufacture

of all raw materials, including zinc, barytes, sulphuric acid, and coal, are required.

In 1920 lithopone was manufactured in seventeen plants, distributed as follows: New Jersey, 5; Pennsylvania, 4; Delaware, 1; Maryland, 1; Illinois, 4; Missouri 1 and California, 1, but 80 per cent of the production came from the eastern or Philadelphia district.

[1] "Barytes, Barium Chemicals and Lithopone Industries," Tariff Information Series, No. 18, U. S. Tariff Commission, 1920.

Lithopone is used extensively in the manufacture of paints, both as a white pigment alone and mixed with other pigments. Another large consumption is in the manufacture of high-grade rubber goods, such as automobile tires, rubber matting, fruit-jar rings, and tubing. In rubber it not only acts as a filler but is valuable for the curative effect which the zinc sulphide has on the rubber. It is also used as a filler in oilcloth, linoleum, and window-shade cloth, and to a smaller extent in printers' ink, and face powder.

Barium Chemicals may be made from either barytes or witherite (barium carbonate). The manufacture and use of barium products has been well described in Tariff Information Series No. 18, from which much of the following is taken.

Distinction Between Blanc Fixe and Barite

Barium sulphate, or blanc fixe, is the best grade of barium sulphate for pigment purposes, both as to whiteness and fineness of the product. In chemical composition blanc fixe is practically identical with natural ground barytes, but its physical properties are different. The two products should not be confused. Blanc fixe is used largely where a pure-white pigment or filler is desired, as in paints, rubber goods, linoleum, oilcloth, and glazed paper. It is also used in lithographic inks, as a base for lake colors, and is used extensively as a pigment by the United States Navy in "battleship gray," which contains about 45 per cent of blanc fixe. Blanc fixe, under the name of chemically pure barium sulphate, is used as an indicator in X-ray photography. It is placed on the market in pulp and as a dry powder. The pulp is a paste containing about 30 per cent of water, and is used chiefly by the paper and lithographic ink manufacturers. The dry powder is used for pigment purposes.

Various Industrial Applications of Barytes

Barium carbonate is a white insoluble barium salt prepared by precipitation from a solution of barium sulphide with soda ash. Its largest use is in the ceramics industry for the manufacture of optical glass, for which purpose a chemically pure product is required.

It is also used in the manufacture of enamels for iron and steel, producing an enamel having the desirable properties of high luster, density, and easy fusibility of lead enamels without the dangers of poisoning attending their use. Recently, it has assumed importance in the manufacture of flat wall paints, and this use will undoubtedly increase.

Barium chloride is a white barium salt which is fairly soluble in water. It crystallizes with two molecules of water and is usually sold in the crystalline or powdered form. It is largely used in the manufacture of blanc fixe and of lake colors, and as a mordant for fixing acid dyes on the inert base, such as aluminum hydroxide or blanc fixe.

Barium nitrate is a soluble barium salt used principally for making barium peroxide or dioxide. Barium monoxide or baryta has its chief use as an intermediate product in the preparation of the binoxide or barium. Barium binoxide, barium dioxide, or barium peroxide, is used chiefly for the manufacture of hydrogen peroxide. It is also used for the production of oxygen and as a bleach, especially in the blanket and straw-hat industries. Barium sulphide is the intermediate barium compound from which the majority of the other barium chemicals are made and is one of the necessary materials in the manufacture of lithopone.

The manufacturers of barium chemicals prefer to use the washed, high-grade barytes of the soft type, but they can and do use the barytes which could not be used in the preparation of the highest grades of ground barytes. The crude barytes is first crushed and mixed with the proper proportions of pulverized coal. The proportion of barytes and coal varies slightly with individual manufacturers; it is generally one part of coal to four parts of barytes by weight. This mixture is roasted for about four hours in a rotating reduction furnace. The barium sulphate is reduced by the coal to barium sulphide during the roasting. The crude barium sulphide (black ash), which contains about 70 per cent of barium sulphide, is then treated with hot water, and a solution of barium sulphide is thereby formed. This solution is used as the starting point for the preparation of the barium chemicals and also in the manufacture of lithopone.

The chief centers of production of barium chemicals in 1919 were in New Jersey, New York, and Pennsylvania (five plants), Illinois (two plants), Tennessee (two plants) and West Virginia (one plant). In 1920 barium chemicals were also made in one plant in California and in one plant in Missouri.

Large quantities of barium chemicals were imported prior to the war, chiefly from Germany. The principal barium salts manufactured or imported are barium sulphate, barium carbonate, barium chloride, and barium peroxide.

The Holt-Christensen Process

In a descriptive article on metallurgical processes in the *Herald Democrat*, a Colorado newspaper, H. G. McClain and W. P. Clary mention the Holt-Christensen process as used by the Tintic Milling Co. and the Tintic Standard Mining Co. in Utah, for the extraction of gold, silver, copper, and lead from ores that are siliceous replacements in limestone. Oxidized copper minerals interfere with cyanidation, and it is desirable to recover the lead, silver, and copper together. The gold content is low, and the losses are not serious. "The entire commercial success of this process depends upon uniform roasting, which is accomplished in the patented Holt-Dern roaster."

The oxidized ore is mixed with sulphide ore to give it a 10 per cent sulphur charge, to which is added 9 per cent salt and from 2 to 5 per cent coal dust. The entire charge is crushed, after mixing to insure uniformity. This charge is given a chloridizing roast at a red heat, the silver, copper, and lead minerals of the ore being changed to soluble salts. The hot ore is then put in wood or cement vats with a filter bottom and leached with an acid brine, the sulphuric acid used being made from the fumes of the roasting, and much of the salt for the brine solution coming in with the roasted ore.

The metals are quite fully dissolved out after five or six days of leaching, and the copper and silver are precipitated by scrap iron. Lead is recovered by electrolytic precipitation. About 35 per cent of the gold is recovered with the silver. The extraction is about 80 per cent of lead, copper, and silver, and costs are about $3 per ton. With reasonable costs of salt and coal, the total margin on ore carrying $15 in silver, copper, and lead should not exceed $7 per ton and might be lower with careful work.

CONSULTATION

A Safety First Record?

"The Gold & Copper Deep Tunnel Mining & Milling Co. has driven a tunnel 5,726 ft. in hard rock and about 1,000 ft. of drifts and crosscuts without accidents of any kind. In a discussion the other day with mining men they contended that, so far as they knew, this was a record in metal mining. In the game of 'safety-first' can the *Journal-Press* cite us its equal? W. P. MCINTYRE,
"Elizabethtown, N. M. Superintendent."

The disasters in mining receive far more publicity than the commendable low-accident records of many mining companies. We have no records in this office which would enable us to give a list of mining operations conducted with an exemplary lack of accidents, but we have volumes giving statistics and details of disasters. Although it is difficult to make a fair comparison, considering the varying nature of mining work, different size of drifts, different character of rock drilled, and other factors, we invite statements from other mine operators who have made accident records equal to or better than the one mentioned by our inquirer. It would be well to indicate the circumstances under which the record was made, with any unusual features that helped or retarded the underground work.

Smelters of Quicksilver Ore

"As I am the owner of considerable cinnabar deposits here in Mexico, would appreciate the favor if you would kindly give me a list of the smelting companies in the United States handling this ore. Would also like to know the price now being paid for this ore by the smelters."

Quicksilver ore in the United States is produced only by companies that have a reduction furnace or retort near their mining operations. Hence the only outlet for your product in the United States would be in California or Texas, where the quicksilver plants nearest Mexico are situated. In view of the high freight rates now prevailing, and the ease with which quicksilver can be recovered from its ores, it would appear advisable to consider doing your own smelting. A moderate heat is sufficient to decompose cinnabar and vaporize the quicksilver, which can be readily condensed. However, in practice it is difficult to obtain practically all of the metal from the ore with a minimum fuel and labor expense. The process is much simpler than that used to smelt other non-ferrous metals.

Quicksilver smelters in California are the New Almaden Co. and the New Idria Co., with offices in San Francisco. In Texas the Chisos Mining Co., at Terlingua, is a producer. Other companies may be cited, but they are mainly inactive and hardly in a position to handle custom ore.

The price of quicksilver is given each week in our market report for the two principal American markets, New York and San Francisco. The price paid for quicksilver ore would depend, as it does for other metals, upon the metallic content of the ore.

A Question of Employment Contracts

"I am informed that there is a law requiring that when a company pays the way of an employee to a foreign country, and the employee completes his contract, or is released or discharged prior thereto by the company, the company is required by law to pay his transportation home, with wages. I am informed that the ———— company tested this in the courts. Can you enlighten me in the matter? Can you also tell me if the case is altered where there is no time contract but the company has paid transportation to the job?"

Inquiry among various governmental authorities fails to confirm our correspondent's inference that any law such as he outlines exists. It would appear that the matter would necessarily have to be provided for by contract, as it is hardly possible that Congress would have the power or jurisdiction to compel any private person or corporation to pay the transportation of an employee on the expiration of his contract, or in case of his discharge. If wrongfully discharged he would have an action for damages, but as to his return voyage after the expiration of his contract, it would have to be covered by the original contract or agreement at its expiration, or he would have to pay for the return voyage himself. It may be that the contract in question was so loosely constructed that its terms admitted of different interpretation. At any rate, this would be a matter for the courts to decide on the merits of this particular case rather than on any law designed for the protection of an employee.

The Unit of Ore

"Please inform me as to just what is meant by the term 'long-ton unit of' as used in regard to manganese ore. As I am interested in a manganese property, and am suffering from miner's consumption, and unable to work, this question is of vital importance to me."

A unit of ore is 1 per cent of a short or long ton, depending upon which weight is used; hence it is equivalent in weight to 20 or 22.4 lb. respectively. The unit is commonly used in the marketing of the ferro-alloy metals, manganese, chrome, tungsten, and molybdenum. However, it is important to know whether the unit refers to the metallic content of an ore or to its content of an oxide or sulphide. Thus, manganese ore is usually sold on the basis of its metallic manganese content, which is expressed in dollars and cents, as, say, 33c. per unit of maganese. Chromite is sold on its Cr_2O_3 content, whereas molybdenum is sold on its MoS_2 content, and tungsten on its oxide content, WO_3. Manganese ore may sometimes be sold on the ton basis, with settlement based on a minimum content of metallic manganese. This is often the rule in sales of exceptionally high-grade manganese ore used in the chemical trades or for battery manufacture, but by far the greater amount of manganese sold is bought on the unit basis of metallic manganese content.

THE PETROLEUM INDUSTRY

Distillation of Oil Shales at Puertollano, Spain

An Enterprise Recently Undertaken by Peñarroya Company —Refinery Producing 3,500 Gal. of Crude Oil Daily

BY ETIENNE A. RITTER
Mining Engineer and Geologist, Denver, Colo.

Etienne A. Ritter

IT IS not generally known, I believe, that prior to the discovery of oil in Pennsylvania, and its recovery through the drilling of oil wells, there were over fifty companies in the United States producing oil from the distillation of coal and oil shales. The success obtained by the Drake well, in Pennsylvania, and the opening up of important oil pools, following closely upon one another, in the United States, made the recovery of oil from shales unprofitable here for many years. It is only lately that the continually increasing demand for gasoline attracted attention again to the future of oil-shale distillation in the United States. But in Scotland, in France, and in some other countries less favored with oil resources and without oil wells, the distillation of oil from shales has long been and is still a profitable industry, its methods continuously improving.

Spain is one of the European countries where the distillation of oil shales is a recent industrial development. About three years ago, the well-known mining company, Société Minière et Métallurgique de Peñarroya, decided to utilize some beds of impure coal and some beds of oil shales found at different levels in some of its coal mines. It has erected a refinery for distilling these oil shales, at Puertollano, in the heart of Spain.

Puertollano is situated about 110 miles directly south of Madrid. It is in the Province of Ciudad Real, on one of the railroad lines which connect the capital of Spain, Madrid, with Lisbon, the capital of Portugal. The oil shales distilled are mined at a depth of 300 ft. in the Asdrubal coal mine, close to Puertollano. Several beds are mined, the most important being one of oil shales, 6 ft. thick. It belongs to the Stephanian formation, of Carboniferous age. The shale is brought to the refinery in railroad cars and stored in large bins.

The refinery is in the outskirts of the town, alongside the main railroad line. It covers an area of about nine acres. The shale is elevated from the bins to the top of the retorts by a bucket elevator. There are fifty retorts in operation, these being placed back to back, in two long rows. There are eighteen large retorts capable of treating four tons in twenty-four hours and thirty-two small retorts of a capacity of one ton per twenty-four hours, each.

The impure coal and the oil shales are sent from the mine already broken to the proper size for feeding into the retorts. The material is screened at the refinery before feeding it to the retorts, and all the material passing through a screen of ½-in. opening is discarded as too fine. It would clog the retorts. The shale used varies between ½ and 2½ in. in size.

The oil shales which are refined there differ greatly in character from those of northwestern Colorado. The former contain 60 per cent ash and the impure coal has 40 per cent. The best vein, from which eventually all the material treated will come, is 6 ft. thick, the shales containing over 30 gal. of oil per ton. At the end of 1922, the refinery was producing 3,500 gal. of crude oil daily from the distillation of these shales.

The large retorts are vertical and of the Scotch (Oakbank) type. In cross-section they are elliptical, with axes almost 3 ft. 8 in. and 16 in., respectively, in size. The height is 26 ft. over all, including the ash grate and the ash pit. The retorts are fed from the top, and one of them has two openings, placed at about one-third and two-thirds, respectively, of the height, through which the progress of distillation may be watched.

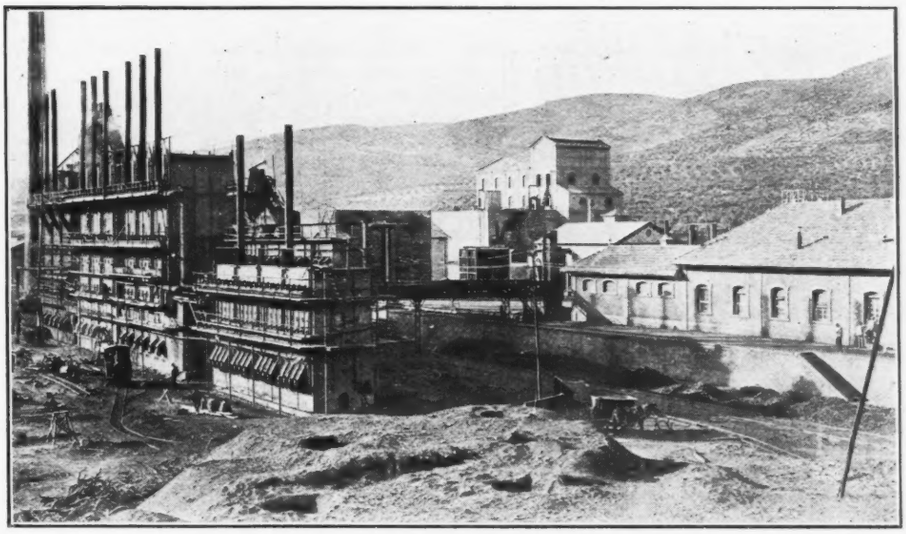
The upper 11½ ft. of the retort is made of cast iron, and the lower 14½ ft. of brick. In practice, an effort is made to distil all the oil out of the shale before the shale passes from the upper cast-iron portion of the furnace to the lower part lined with brick.

The gases, together with the oil, which is held as microscopic drops in suspension in the gases, are sucked out and carried off for further treatment. They are taken out at a point in the upper part of the retort. Superheated steam is injected in the lower part of the retort, first to clean up the gases in the bottom which may have been carried with the shales in their downward travel, second to prevent the cracking of the oils under the influence of the heat, and, third, to decompose the nitrogen compounds and to recover them as ammonia. The worthless ashes are removed at the bottom of the retort and sent to the dump.

The gases and the oil vapors pass through a series of

water coolers, where the oils are condensed and washed in water, which retains the ammonia. The oils and the ammonia water are separated from each other by gravity. The ammonia water is collected, heated with lime, and the recovered ammonia is sent to a saturator filled with sulphuric acid. The product obtained is ammonium sulphate, which is bleached in the saturator by the addition of crude oil and sold to the farmers as fertilizer.

The liquid oils are gathered by themselves, and what is left finally is the gases rich in gasoline and kerosene. The liquid oil, or crude oil, is distilled fractionally in iron stills. Thus a number of products are obtained, ranging from oil with 0.815 specific gravity, as the lightest product, down to oil coke. The oils are separated into kerosene and lubricating oils, phenols and paraffine oils. The paraffine is extracted by cooling and sweating, and in the last operation some exceedingly heavy lubricating oils are also recovered by the company.



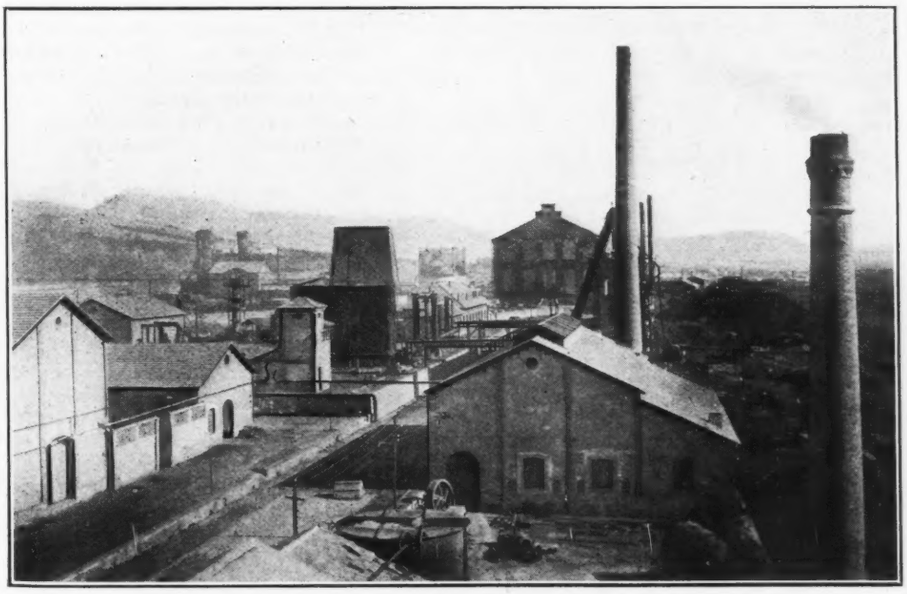
Power plant and batteries of large and small retorts at Peñarroya company's oil shale distillery, Puertollano, Spain

After the gasoline and the kerosene have been extracted, the gases are finally retained as dry gas. One-half of the amount produced is burned to furnish the heat needed in the retorts. The other half is mixed with ordinary coke gas and is used to run the engines of the central power plant. This plant has a capacity of 3,000 kw. and furnishes power to the refinery as well as the coal mines.

The prices paid in Spain for the products obtained are higher than those paid in the United States. Gasoline sells for 0.80 peseta per liter; kerosene 0.60 peseta per liter; paraffine, not bleached, 0.70 peseta; ammonium sulphate, 550 pesetas per ton; and lubricating oils 0.70 peseta per kg.

With Spanish exchange at 15.75, this means that gasoline sells approximately for 52c. per gallon and kerosene for 39c. per gallon.

I am indebted for much of the information contained in this article to Jacques E. Weigle, engineer and chemist in charge at the refinery of Puertollano, who took me through it in April, 1922.



Ammonium sulphate, lubricating oils and paraffine departments of Puertollano plant

Concession on Esthonian Oil Shale Granted English Company

In November, 1922, a concession was granted in Esthonia to an English concern, the Esthonian Oil Development Syndicate, Ltd., to exploit the area around Vanamoisa during the next ninety-nine years. Information to this effect from the Esthonian Consulate in New York is published in a recent issue of *Commerce Reports*. Dwelling houses, workshops, machinery, and all developments made to date are to be left in possession of this concern under its terms. For this concession the company will pay £100,000, of which 50 per cent is to be paid by Oct. 31, 1923, and the remainder in preferred stocks of the Esthonian Oil Development Syndicate, Ltd., on which 6 per cent will be paid in addition to yearly dividends. This English concern agrees to call in the preferred stock during five years at its par value. Under normal conditions this company can obtain 3,000 additional hectares.

New Books

Developing a Coal Mine in the Far North

America in Spitsbergen. By Nathan Haskell Dole. Marshall Jones Company, Boston.

This is a handsome book of two volumes, each of about 450 pages, recounting "the romance of an Arctic coal mine", as the sub-title states. It describes the courageous and intelligent attempt made by John M. Longyear, of Marquette, Michigan, to exploit the coal of Spitsbergen. The book quotes freely from his diaries, and, in effect, it is a memorial to him published by his wife. Advent Bay, where the coal mine is situated, is 550 miles from Tromsö, the chief port of northern Norway. In 1901 Mr. Longyear, with his family, traveled on an excursion steamer to the North Cape and Spitsbergen. His diary records the fact that he heard of men that were prospecting for coal. In 1903 he went to Spitsbergen and obtained samples of the coal, which proved to be a high-grade semi-bituminous product. In 1906 the Arctic Coal Company was registered in West Virginia by Mr. Longyear and his partner, Frederick Ayer of Boston. One seventh of the stock was held by the Norwegian syndicate from which the property had been acquired. A good start was made, but already many of the troubles that hampered operations during ensuing years were in evidence: the drink curse, which made the workmen inefficient and disorderly, the difficulty of getting things done promptly and properly, the exasperating stupidity of officials, the Norwegian unfriendliness to American enterprise, and the uncertainty of title, due to the political status of Spitsbergen. In 1910 the company was threatened by trespassers, and began to realize that it had aroused antagonism by locating too large an area. During that season 121 men were employed, of whom only six were miners. This suggests one of the obstacles to success, the scale of the operations being too small in proportion to the overhead expenditure.

In 1911 Scott Turner, formerly on the editorial staff of the 'Mining and Scientific Press', became manager. He took hold in characteristic fashion. By that time $430,853 had been spent in the purchase, equipment, and development of the mine. The exception was to develop an enterprise capable of making sales of 200,000 tons of coal per annum. The price was 19 shillings per ton c.i.f. In 1913 the production was 37,678 tons. Writing in his diary in 1914 Mr. Longyear said: "The industrial conditions are very peculiar . . . We get enough of the scum of the earth to keep things stirred up all the time. Its inaccessibility for nine months every year is one mighty important one that calls for great strength of character and poise on the part of the men on whom the responsibility falls. Every resource of mind and strength is called upon during the long winter. More or less insanity crops up in the long dark night, and gruesome things happen . . . An industrial enterprise in the Arctic is no joke". The war, of course, upset everything. The force at the mine was reduced by half, and the staff was cut down in proportion. All development work was stopped. Supplies were scarce, mails were seized, machinery was unprocurable, and conditions generally made operations almost impossible. Nevertheless an output of 44,000 tons of coal was made during the winter and up to July of 1914. Only 17,692 tons however was shipped. It was decided to close down the mine, and not to attempt any work during the coming winter. Negotiations for a sale were started with several parties, and on September 1, 1916, the property was sold to a Norwegian syndicate. The cash proceeds of the sale amounted to $404,000, as against a total expenditure of a little more than a million dollars. The stock in the new company had a par value of $522,000, but what its real value was, or is, we are not told. Mr. Ayer died in 1918 and Mr. Longyear only a year ago. Their coal enterprise in Spitsbergen did not succeed because the lack of a government and the obstructive tactics of the Norwegians imposed many difficulties; other obstacles were the shortness of the season, the difficulties of transport, and the small output of coal in proportion to the general expense. Those in control set 200,000 tons as the scale of production that would be profitable. That point was never reached. Nevertheless, Mr. Longyear's friends, and more particularly his devoted wife, are right in looking upon this Arctic adventure as worthy of honorable remembrance. It exhibited Mr. Longyear's ability as a leader of men, his power to win the cordial cooperation of a series of energetic and resourceful young American engineers, his humane treatment of employees, his sagacity in business affairs, and his courage as a pioneer in one of the waste places of the earth.

T. A. RICKARD.

Of Interest to Shippers

Railroad Freight Transportation. By L. F. Loree. D. Appleton & Co., New York. $5.

In "Railroad Freight Transportation" Mr. Loree has given us a book embodying all phases of his subject: History, Operations, Experiences, Reminiscences. It might almost be called a book of Rules and of Instructions, and a Code of Ethics.

This is not a volume to be read hurriedly as one would read a "best seller," but should be read carefully and studiously and then placed in one's office library as a book of reference. The practical problems of freight transportation are dealt with as only an expert could do, and all phases are treated, from those of track construction, drainage, switches, and other construction phases, to those of freight tariffs, operations, and accounting. Much good advice, clearly intended as such, is interspersed throughout the book.

The many departures from the text are always interesting, if not always consistent. One would hardly expect to look in such a volume for advice on hygiene or a treatise on heredity, but one finds them there, well treated, convincing, so that excursions into other realms of science may therefore be considered excusable.

When the author deals with the historical phases in the development of the various features of his subject, he is particularly interesting. The chapters on Demurrage, Per Diem, the Development of Standard Time, and the History of Early Railroading are as interesting as they are informative, and in the accumulation, assembling, and presentation of his subject matter, Mr. Loree has given evidence, in the finished work, of the competent, painstaking, and efficient executive.

In dealing with the subject of men—the relations of employer and employee—the history and development of the various labor movements, seniority, discipline, and related subjects—Mr. Loree has given us a textbook as well as a history. This section, the largest in the book, comprising over two hundred pages, is ably handled, based on experience rather than theory, and the importance the author attaches to these features is indicated by the exhaustive manner in which he treats of them. His well-known activities in all important disputes of recent years between the railroads and their employees qualify him to speak with knowledge and with judgment.

F. R. RAIFF.

Canadian Geology

Elementary Geology, with Special Reference to Canada. By A. P. Coleman and W. A. Parks. J. M. Dent & Sons, Ltd. London and Toronto.

This is an excellent little treatise on elementary geology, following essentially the more or less stereotyped lines of the larger textbooks. We are not sure as to the advisability of bounding geology by political lines, which is the central idea of this book. It has not been the general custom to do so consciously; on the other hand, it may be admitted that a great deal of it has been done subconsciously and naturally. English textbooks give British instances. American books describe chiefly the United States; French books the geology of France. Still it is not a desirable characteristic and spells provincialism; so that we doubt the virtue of embracing it voluntarily. Science knows no boundary created by nationality or tongue; and the scientist should find, on reflection, that it is incongruous so to group earth science—remembering that:

"Those that walk
The Earth are but a handful to the tribes
That slumber in its bosom."

J. E. SPURR.

SOCIETIES, ADDRESSES, AND REPORTS

Dr. Berkey Describes Hunting for Facts and Other Things in Mongolia

Sketches Briefly Work Done by Third Asiatic Expedition in 1922—Many Fossils Found

Chasing the wild ass at 40 miles an hour over the plains of Mongolia in automobiles was only one of the varied experiences of the members of the Third Asiatic Expedition, which left New York last spring and but recently returned, according to Dr. Charles P. Berkey, a member of the party, who addressed Columbia alumni at the university on Feb. 12. As Dr. Berkey put it, the expedition left New York in pieces and assembled in Peking. Its purpose was to do geological, palæontological, zoological, and various other kinds of scientific exploration work in regions never before visited. To this end the route was carefully laid out through places where travelers so far as known had not been. The results were of great value. A large amount of mapping was done, over 700 square miles of ground was accurately surveyed, many fossils were collected, and much data of scientific worth compiled.

Central Asia is a hard country to travel in—desert, without roads or places at which to buy supplies, according to Dr. Berkey. The party fitted out with motor cars, just the same, and with seventy-five camels to supplement the motors. Automobiles were able to travel a large part of the Gobi desert, he said, provided the proper mechanical care and support were given them.

The geological features and history of Central Asia were broadly sketched by Dr. Berkey. He spoke principally of the search for fossils, of how the probable location of the beds where they were to be found was first determined and then the fossils themselves discovered. He told how they were able to fix the geological date of the beds by the fossils found, accurately enough, at least, for a geologist, he said, to whom an error of 2,000,000 years or so made little difference.

Dr. Berkey told of one locality marvelously rich in fossils, where he and two of his fellow members worked one day, all within talking distance of each other, one of them gathering fossil fish, another dinosaur bones, while he, himself, dug fossil butterflies and mosquitoes—and the mosquitoes were the finest he ever saw.

Interesting contacts with the Mongols were made, affording many a glimpse of their nomadic life. A peculiar thing about the desert, said Dr. Berkey, was that no matter where one went or how far he thought he had removed himself from the rest of mankind, he was sure to find someone there before him. The Mongols had a peculiar habit of dropping in on one from nowhere, when one was working in the open.

Among the interesting discoveries was one of rock sculptures depicting animals not now found in the region. Another was a monolith and still another a dam half a mile long, erected by prehistoric builders.

Dr. Berkey's talk was informal and was illustrated with fine lantern slides and lasted less than an hour. It served to indicate how interesting the official report of the expedition will be when it is eventually made.

"What About Silver?" the Topic of Boise Meeting

The tenth annual meeting of the Idaho Mining Association was held at Boise, Feb. 13-14. What action was to be taken to obtain a fair price for silver when the Pittman Act purchases were completed was the chief topic discussed. The Federal "blue-sky" law and proposed state mining taxation were also considered. Stewart Campbell, State Inspector of Mines, delivered an address on the "Blue-Sky Law and Idaho." Professor Francis A. Thompson, dean of the Idaho School of Mines, spoke on the "State Bureau of Mines and Geology." A report on the association's activities in the last two years was made by the secretary, Ravenel Macbeth.

Slate Industry Adopts Advertising Policy

The adoption of an advertising policy was perhaps the most far-reaching move made by the National Slate Association during its recent meeting in New York. The sessions were given over to a discussion of such subjects as "Production Problems and the Elimination of Waste," "Trade Co-operation," "Scope of 1923 Activities," and "Traffic Matters."

The slogan "Slate — Consider Its Uses," was adopted in recognition of the advisability of stimulating wider general interest and of educating the public as to the many and varied uses of slate. Another marked step in advance was the establishment of a traffic bureau to supply full information as to shipping and routing. G. E. Brown, of Belleville, Ill., was appointed traffic commissioner. Appropriations for research work and special tests were made.

1922 a Bad Year for Mining in China

Situation Described at Dinner of Mining Institute at Peking—Future More Promising

The second annual dinner of the China Institution of Mining and Metallurgy was held at the Grand Hotel in Peking on Dec. 21, 1922, with twenty-six members and guests present. John P. Kenrick, managing director of the Peking Syndicate, acted as president. Among the speakers was Dr. A. W. Grabau, who spoke interestingly on the association of mining and geology in various countries. Mr. Kenrick, in proposing a toast to "The Mining Industry in China," said that the industry had passed through a difficult period in 1922, with the result that several large companies in the central provinces had shut down entirely and many others, especially those dependent on railways for disposal of their products, had had to restrict operation through failure to obtain sufficient cars.

The Washington Conference, in Mr. Kenrick's opinion, would probably have a beneficial effect upon the industry in China, if it succeeded in removing the suspicion that unfortunately existed in the minds of many Chinese that other nations were trying to exploit the country's mineral wealth. This suspicion, he said, was largely responsible for the conservativeness displayed in forming China's mining policy.

Increase of the customs import tariff to an effective 5 per cent was having some slight effect upon development of industry within the country, said Mr. Kenrick, and it was hoped that abolition of *likin* (provincial taxes levied on imports or articles in transit) and increase of the import tariff by the further 7½ per cent contemplated would not long be delayed.

Of more immediate importance to the mining industry, according to Mr. Kenrick, was the statement made by the Chinese delegation to the conference, of the purpose to develop existing and future railways in accordance with the general program that would meet the economic, industrial, and commercial requirements of China. The country was so vast and its mineral deposits were so widely distributed, said Mr. Kenrick, that mining was even more dependent upon railways than in other countries. Without provision of efficient and cheap transport by the railways now in operation the working of existing mines was impeded, mining development could not take place, and serious inconvenience to commerce from shortage of coal and other raw materials must occur.

Labor unrest had contributed somewhat to the setback to mining mentioned, the speaker continued. It was unfortunately true that the Chinese miner, naturally peaceable, hard-working, and law-abiding, was easily influenced by agitators, who during the last year or two had been paid from political funds to disorganize industry with a view to weakening the government authority. The miner, however, in all cases returned to work within a short period, when satisfied that he was being dealt with fairly.

Who Is Striving for Standardization?

Albert W. Whitney, chairman of the American Engineering Standards Committee, delivered an address on the need for standardization at the New York State Industrial Conference recently held, stating incidentally:

There is a standardization that endeavors not only to operate on a national scale and to cover all industries but to bring all points of view, that of the manufacturer, the consumer and the public, to a common focus. There are three organizations that are bearing the brunt of this work, the United States Chamber of Commerce, the Department of Commerce of the Federal Government and the American Engineering Standards Committee.

The United States Chamber of Commerce is doing a valuable work in interesting manufacturers in standardization and particularly in simplification. The Department of Commerce is advancing standardization in two ways; through the Bureau of Standards and the Division of Simplified Practice, which is engaged on the non-technical side of the field of standardization. The third national body is the American Engineering Standards Committee. This body serves as a clearing house for standardization. The process is this: When there has been brought to the committee's attention in a convincing way the fact that there should be standardization in a given field, a conference is called and to this conference are invited all national associations and other representative bodies that are known to be interested. This conference decides whether standardization should be undertaken, and if the decision is in the affirmative it makes a recommendation to that effect to the American Engineering Standards Committee and also with regard to the national association or other representative body which shall act as sponsor in the preparation of the standard.

The sponsor that is chosen by the American Engineering Standards Committee creates a sectional committee. This sectional committee, represents the bodies interested in the particular project. When the committee has completed its work the standard is turned over to the American Engineering Standards Committee for approval. The American Engineering Standards Committee passes solely upon the question of whether the work has been done in a representative way.

Men You Should Know About

H. R. Chartran is in Boryslaw, Galicia.

Henry C. Perkins is enjoying a holiday in Egypt.

A. V. Eulich sailed on Feb. 10 for Cherbourg, France, en route to the Belgian Congo.

R. G. Hall, formerly manager for the Burma Mines Corporation, is now a resident of San Francisco.

Captain Frank Kent, general manager of the Chandler Mining Co., at Ely, Minn., is spending the winter at San Fernando, Calif.

Yozo Tamura, New York representative of the South Manchurian R.R. Co., Ltd., was a recent visitor on the Mesabi iron range.

C. A. Bonine has been appointed professor of geology, in charge of the department, by the trustees of Pennsylvania State College.

Harry T. Hulst, chief engineer of the Oliver Iron Mining Co. on the Marquette Range, has completed a trip over the Vermilion and Mesabi ranges.

G. E. Stowell, formerly mining engineer for the Oregon Bureau of Mines, is now with the Beaver Gold Mining Co., at Granite, Ore., as mill superintendent.

Theodore J. Romanoff, formerly general manager for the Kyshtim company in Siberia, was recently in San Francisco, after a tour in the West. He has returned to Japan.

H. C. Dudley, vice-president of the Ahumada Lead Co., has left Duluth for the Southwest, where he will visit many of the mining camps, including the property of the Ahumada Lead Co.

Charles H. Munro is expected soon in San Francisco from the Malay States, on a holiday. **E. E. McCarthy** has gone to Ipoh to take his place there, temporarily, as manager for the Yukon Gold Co.

Harry H. Angst, former general pit foreman for the Oliver Iron Mining Co., in the Chisholm district, has resigned this position and accepted the superintendency of the Maroco mine, at Trommald, Minn.

Bulkeley Wells, president of the United Comstock Mines Co., and **John Fulton**, superintendent of the Idaho-Maryland mine, at Grass Valley, Calif., have left Virginia City and the Comstock after a week's visit.

John R. Reigart, mine superintendent for the United Comstock Mines Co., at Gold Hill, Nev., has resigned. He is succeeded by **John P. Caulfield, Jr.**, formerly underground foreman for the Nevada Consolidated Copper Co., at its Ruth mine, near Ely, Nev.

Mining and metallurgical engineers visiting New York City last week included: **M. Morimoto**, of Tokyo, Japan; **J. D. Robertson**, of St. Louis; **L. D. Godshall**, of Los Angeles; **Marshall D. Draper**, of Kotchiu, Yunnan, China; **Frank A. Crampton**, of Los Angeles; and **J. B. Tyrrell**, of Toronto, Ontario.

Arthur Crowfoot, who has been superintendent of the mill at the Morenci branch of the Phelps Dodge Corporation, has recently visited Bisbee, Nacozari, Cananea, and the Globe-Miami districts. He will leave for Bisbee, on March 1, to take temporary charge of the new concentrator at the Phelps Dodge Copper Queen branch.

Frederick Burbidge, of Wallace, Idaho, general manager of the Federal Mining & Smelting Co., left on Feb. 4 for Havana, Cuba, and from there will proceed to the eastern part of the island to visit his son. Mr. Burbidge stopped on the way in southern Idaho and in Oklahoma, where the Federal company has lead and zinc mines. Returning, he will sail from Cuba to New York.

Society Meetings Announced

The Iron and Steel Institute will hold its annual meeting on May 10 and 11, in London.

The twenty-fifth annual meeting of the **Canadian Institute of Mining and Metallurgy** will be held at Montreal, March 7-10.

The dates on which the **Tenth National Foreign Trade Convention** will meet in New Orleans have been postponed to May 2-4.

The American Society of Mechanical Engineers will hold a joint meeting with the A. S. C. E., the A. I. M. E., and the A. I. E. E., on March 21, at the Engineering Societies Building in New York City.

The forty-third semi-annual meeting of the **American Electrochemical Society** will be held in New York City, at the Hotel Commodore, May 3-5. One of the principal attractions of the technical program will be a whole day session on the general topic: "The Production and Application of the Rarer Metals." There will be papers on vanadium, tungsten, cobalt, molybedenum, zirconium, cerium, uranium, tantalum, calcium, magnesium, and others.

Obituary

Thomas Bardon, head of the Shattuck Arizona Copper Co., died in Ashland, Wis., on Feb. 1. He was born in Maysville, Ky., seventy-four years ago, and had been president of the Ashland National Bank since 1886; president of the Denn Arizona Copper Co., Northern Chief Iron Co., and was identified with various timber and land companies in California and Washington. He was mayor of Ashland, Wis., four terms.

THE MINING NEWS

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Leading Events

A DEMONSTRATION, at Martinsburg, W. Va., of the use of liquid-oxygen explosives for blasting, satisfies observers of the practical advantages of the method.

The Golden Feather Mining Co. starts its new cyanide plant in the Black Hills of South Dakota coincidentally with the suspension of milling operations by the Trojan Mining Co. in the same district. The latter announces an active campaign of development and exploration to open ore. The mill will be improved.

The Chile Copper Co., owner of "greatest copper mine," pays initial dividend.

The Anaconda Copper Mining Co. announces that it will not "guarantee" producers $1 price for silver in purchased ore after April 1.

The Calumet & Arizona Mining Co. plans the expenditure of $750,000 in improving its smelter at Douglas, Arizona.

Fire in Federal Mining & Smelting Co.'s Morning mine, in Idaho, after claiming three victims, is extinguished.

The Copper Queen Branch of the Phelps Dodge Corporation is almost ready to start steam-shoveling Sacramento Hill, at Bisbee, Ariz.

The Witherbee, Sherman Co. has installed equipment for liquid-oxygen blasting in its iron mines at Mineville, N. Y.

Congressional investigation of gold-silver economics seems assured.

Liquid Oxygen Explosive Demonstrated at Martinsburg, W. Va.

Blasting Tests Conducted by Adolph Messer at Quarry of Kelley Island Company—Arranged by U. S. Bureau of Mines

BY A. H. HUBBELL
Managing Editor

THE first public demonstration in this country of blasting with liquid oxygen explosive took place Feb. 7 at the quarry of the Kelley Island Lime & Stone Co., about two miles west of Martinsburg, in the panhandle of West Virginia. Tests arranged by the U. S. Bureau of Mines were conducted by Adolph Messer, head of the German firm of Messer & Co., who has been in this country on business. In general the tests gave satisfactory results, and were of great technical interest.

As described by A. D. Akin in the *Journal-Press* of Dec. 2, 1922, this explosive, in general, is made by soaking sticks of carbon in liquid oxygen on the spot where the blasting is to be done. The holes are then loaded with the saturated cartridges as quickly as possible, and blasting follows with the minimum loss of time, either electric exploders or the ordinary cap and fuse being employed. Blasting must follow quickly after the cartridges are removed from the soaking receptacle, because they soon become inert, due to the evaporation of the oxygen.

The liquid oxygen used was made at the plant of the Southern Oxygen Co., Washington, D. C. It was taken from the column between 1 and 5 p.m., Monday, Feb. 5, and conveyed to the quarry at Martinsburg in double-wall containers of the vacuum-bottle variety, most of the containers holding 15 liters or approximately 35 lb. Five-liter containers were also used. The container is not kept corked, but has a hinged perforated metal cap. One is shown in the accompanying photograph. Oxygen is steadily lost from the containers by evaporation. By 7:30 o'clock, Tuesday morning, Feb. 6, the average loss, according to the representative of the oxygen company, was 1½ lb. per 35-lb. container. The loss, it was stated, averages less than 0.5 per cent per hour. Corking or closing of the container will result in its breakage.

Carbon cartridges of two kinds were used in the tests. One (D2) consisted of pure acetylene lampblack, and the other (A2) of acetylene lampblack mixed with 25 per cent ground cork. The former, according to Mr. Messer, is considered equivalent, when impregnated, to 80 per cent dynamite, and the latter to 60 per cent dynamite. The lampblack was loosely wrapped in blotting paper so as to form roughly cylindrical sticks 300 mm. (about 12 in.) long, and 35 or 40 mm. in diameter. These sticks before soaking in oxygen can be easily compressed with the fingers. After soaking they are frozen and brittle. Most of the cartridges used in the test were 40 x 300 mm., each containing 75 gm. of pure lampblack. Immediately after soaking they weighed about ¾ lb. each, indicating a ratio of absorption of about 3½:1.

No. 8 electric exploders were used in the principal tests, one to each hole or charge. The cap was inserted in a hole bored through a wood cylinder or plug about 4 in. long and somewhat less in diameter than the drill hole. Cap and plug were then lowered into the hole by the leads until they rested on the charge. Firing was done with a No. 4 blasting machine of the Aetna Explosives Co.

The program included the blasting of one round of two holes, one of three holes, one "block shot," and two "pasters" or "mud caps."

The two holes shot first were about 2 in. in diameter at the bottom and 20 ft. deep, drilled almost vertically and 10 ft. back of the quarry face. They reached practically to the level of the quarry floor, and at that level were approximately as far in from the face as at the top.

The cartridges were prepared close to the collar of the hole. The equipment assembled for this purpose is shown in the photograph. Carbon sticks were placed upright in the double-walled soaking containers, which held

from 12 to 18 sticks, according to size. Liquid oxygen was then poured in from the oxygen container, flowing in a small steel-blue stream from the orifice. Rapid evaporation accompanied the pouring. The soaking cans were then closed and the sticks allowed to soak about fifteen minutes. At least six minutes is required for proper soaking, according to the oxygen company representative, and oversoaking is better than undersoaking.

The cartridges were then removed one by one, as frozen sticks, from the can and dropped into the hole. If

Blasting equipment assembled at collar of hole. Double-wall liquid oxygen containers, each holding 15 liters, on left. Soaking cans filled with carbon cartridges on right. Electric exploders and wooden plugs rest on top of one of the two soaking cans

properly soaked, the entire cartridge should be saturated, though the bottom will be supersaturated. Immediately there was a rapid evolution of vapor from the hole, demonstrating the rapidity with which oxygen was being lost. Eighteen D2 cartridges were used in each hole. The charge was then carefully packed down with a long wooden tamping rod. An electric exploder and wood cylinder described above were lowered into each hole, a half powder box of fine sand poured in by way of tamping, the wires tested, and the blast fired. Loading consumed four minutes and the blast was fired within seven minutes after the first cartridge was dropped. Three men were employed in loading the two holes.

As a result of the blast, the ground was badly shattered over an area extending 15 ft. back of the face and 50 ft. along it. A moderate tonnage was thrown into the quarry pit. The general impression created, however, was favorable.

In the second test, three holes, respectively 20 ft., 16 ft., and 20 ft. deep, drilled almost straight down and 7 ft. apart in a line parallel with the quarry face and 8 ft. back of it, were loaded as before. The cartridges were soaked nineteen minutes, and two men loaded the three holes in six minutes. Sixteen ¾-lb. sticks were placed in each 20-ft. hole and 12 sticks in the 16-ft. hole. The blast failed, however, though all three of the detonators exploded. This was explained by the theory that the evolution of gas from the charge had lifted the wood cylinders carrying the detonators, thus permitting the sand tamping to get between the exploders and the charge.

After an hour had elapsed, the inert carbon charges were easily blown out of the holes with compressed air. The 16-ft. hole and one of the 20-ft. holes were then reloaded. Soaking took fifteen minutes and loading three minutes, two men loading the 20 ft. hole and one man the 16 ft. hole. The third hole was abandoned because of insufficient oxygen. The manner of loading was changed in this test. Twelve cartridges were put in each hole before the electric detonator. Most of them were of the A2 variety, containing 25 per cent ground cork and 75 per cent acetylene lampblack. On top of each exploder were then placed three D2 cartridges, followed by two A2 cartridges. Sand tamping was again used. Before loading was finished, difficulty was experienced by the action of the escaping gas in blowing the sand and some of the topmost cartridges from the holes. These were finally wedged in and the charge was blasted. One hole broke well. The other was again a failure, giving a pyrotechnic display as flame from it spurted into the air. The opinion was expressed by Mr. Messer that the use of sand was evidently a mistake, though the first time it gave no trouble.

A "paster" or "mud cap" shot gave remarkable results in shattering a huge block of stone in the quarry pit. Ten sticks of D2 explosive were fired with 8X cap and fuse. Two other minor tests gave good results.

During the tests the oxygen and cartridges used were not weighed, so that the total quantity of explosive used could only be gaged approximately in terms of "cartridges."

About twenty-five witnessed the tests, including a number of Bureau of Mines officials. Besides Mr. Messer and his asscciates, M. Keith Dunham and Mr. Luening, there were: George S. Rice, Bureau of Mines; Fred Hellmann and S. S. Sorenson, of New York City; ex-Senator Faulkner, of West Virginia; C. R. Orndorff, Bethlehem Steel Corporation; M. J. Connelly, of M. J. Connelly Co.; R. B. Swope, Southern Oxygen Co.; Mr. Thompson, Linde Oxygen Co.; and H. C. Bellinger, of New York. Among the Bureau of Mines representatives were: E. B. Swanson, M. Van Siclen, J. E. Tiffany, J. E. Crawshaw, Dr. C. E. Munroe, R. V. Ageton, D. J. Parker, E. H. Denny, J. W. Paul, and H. C. Howarth.

The Kelley Island company produces limestone for open-hearth steel work, its output now being about 1,000 tons a day. It employs from 135 to 150 men.

Miami Copper Co. Experiments With Vocational Education for Foremen

During the last two weeks there has been conducted a conference on foremenship for the foremen and superintendents of the Miami Copper Co. at Miami, Ariz. This conference was made possible by a co-operative arrangement made between the company, the Arizona State Board for Vocational Education, and the Federal Board for Vocational Education. J. C. Wright, director of the federal board, of Washington, D. C., was conference leader.

The object was to apply the principles of foremenship training to the organization of a mine along lines that have been so successfully applied to the staff of some of the large manufacturing concerns of the country. The purpose of the classes is to instruct the foremen in the technique of handling men and to analyze comprehensively the responsibilities and relationship of the bosses to the company and to the workmen under their direction.

The men attending the conference were organized into two groups, one consisting of twenty shift bosses and general foremen, and the other group of twelve superintendents, engineers, and other company officials. In addition to these men, there were several officials from other companies operating in the district, who are interested in the work and who attended one or more of the meetings.

Magma Copper Progresses With Smelter Construction

From Superior, Ariz., come reports that the Magma Copper Co.'s new brick plant, which was built to supply the material needed in the construction of the new smelter, is now producing about 25,000 bricks daily. These bricks are said to be of excellent quality and far superior to the output of most of the plants in the West. The requirements for the smelter alone will be between 2,000,000 and 3,000,000 bricks, and at least 1,000,000 will be required to fill outside orders. The full capacity of the plant is 60,000 bricks per day.

What Granby Con. Will Get With Canada Copper Corporation

Railway, 2,000-ton Mill, and Large Body of Low-Grade Copper-Bearing "Rock"

By Robert Dunn

The probable aquisition by the Granby Consolidated company of the mine and plant of the Canada Copper Corporation directs attention to the latter properties, which are situated close to Princeton, B. C., and upon which much development has been done. Not only has much diamond drilling and other exploratory work been carried out, with the result that a large body of low-grade copper-bearing "rock" has been proved, but a concentrator has been erected at Allenby, some miles distant. A railway has been constructed from the mill to the mines at heavy expense. It was stated, at about the time the mill was completed, that a contract had been entered into with the Consolidated Mining & Smelting Co. of Canada for the shipment of the concentrates to the Trail smelter, and power was to be supplied by the Kootenay Power & Light Co., from Bonnington Falls, near Nelson, the extension of the wires for this purpose having been practically completed. Suddenly the project of actually mining and milling the ores of Copper Mountain came to a halt. The low price of copper at the time was generally given as the explanation.

Engineers claim that the preliminary work at Copper Mountain proved 10,000,000 tons, with another 2,000,000 tons of probable ore; the average is given as 35c. per ton in gold and silver, and 34 lb. of copper per ton. As to the mill, its capacity is placed at 2,000 tons a day, and a trial run in 1920 was satisfactory except in one particular. The ore proved to be tougher than expected, and it was found that heavier crushers and rolls would be necessary. Since that time the plant has been idle. The cost of the railway, which runs up the Similkameen River and gives the mine connection with the Kettle Valley Ry., is estimated to have been $2,000,000, having proved one of the heaviest pieces of construction ever put through in a country with a reputation for costly railway work. To put it in condition for use doubtless would mean a substantial outlay.

Jackson Mine Changes Hands

R. C. Andrews, of Boston, with his brother, N. J. Andrews, of Joplin, Mo., and Boston associates have purchased the Jackson mine, near Crestline, Kan., from W. D. Mardick and associates. The new owners are understood to be backed by several Pittsburgh steel capitalists. The Jackson mine has been operated on only a modest scale as a lead producer, and the owners have heretofore been handicapped by lack of water. The new owners will sink the shaft to a deeper level, where water is found, and will immediately erect a new modern concentrator to the west of the small mill already on the lease.

Anaconda Protects Itself on Pittman Act Silver

It is reported that the Anaconda Copper Mining Co. has notified shippers to its smelter that after April 1 it will not guarantee $1 an ounce for silver, owing to the anticipated expiration of the Pittman Act. This is not understood to mean that the dollar price will not be realized by the miner after that date. The price will depend upon whether the Anaconda company itself gets $1.

$750,000 Improvements for C. & A. Smelter at Douglas

John C. Greenway, general manager of the Calumet & Arizona Mining Co. at Bisbee, Ariz., has announced that work on additions and improvements to the company's smelter at Douglas, Ariz., to cost $750,000 will be started soon. These will include a new sampling and crushing plant. Additional equipment will also be installed for making sulphuric acid.

Indian and West Australian Gold Output

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, Feb. 9—According to figures made public here, the Indian gold output during the month of January was 32,059 oz., and the West Australian gold output for the same period amounted to 41,925 oz.

Work Resumed After Fire in Morning Mine at Mullan, Idaho

Three Lives Lost in Federal Company's Property—Fire Started on Jan. 23 —Extinguished in Eight Days

Work was resumed on Feb. 5 after the fire in the morning mine of the Federal Mining & Smelting Co. at Mullan, Idaho, in which three miners lost their lives. The fire was discovered on the 1,400 level of the Morning mine, on the morning of Jan. 23 while the day shift was being lowered to work. The men were quickly raised, but in checking up one man was found to be missing. Two of his associates volunteered to go after him and were lowered to the 2,000 level. When they failed to signal in the designated time, helmet men went down and found the rescuers overcome by gas, from which they never recovered. The dead body of the missing man was afterward found in the manway below the 2,000.

Helmet men from the Hecla, Bunker Hill, Hercules, and Tamarack mines joined those at the Morning in fighting the fire, and early the following morning the U. S. Bureau of Mines rescue car arrived from Butte. A deluge of water was pumped into the 1,200 level from the sump on the same level, to which the water is elevated from the 2,000. In this manner the fire was finally reached, and at the end of eight days it was extinguished. Powerful fans used in ventilating the mine were turned on to drive out the gas, and on Monday, Feb. 5, the mine was pronounced safe and operations were resumed.

Trojan Company Suspends Mill Operation at Deadwood, S. D.

New Ore Will Be Developed and Mill Remodeled—No Profit Under Present Conditions

By Otto Ellerman

The Trojan Mining Co., of Deadwood, S. D., suspended milling operations for an "indefinite" period on Feb. 10. This step is made necessary by the fact that continued high costs prohibit profitable operations on the present developed ore. More active development will be undertaken to give employment to as many men as are now employed. The Trojan company began milling in 1911, and since that year the plant has been in continuous operation. Approximately $4,000,000 in bullion has been taken from the property during the period of successful operation. The suspension comes as a surprise to outsiders. The following statement is made by C. E. Dawson, general manager for the company:

"Continued high cost has influenced us in reaching this decision. It has been necessary for us to confine our mining operations to a higher grade of ore than formerly, in order to pay operating expenses. This has meant reduced tonnage, with very little reduction in costs. Our present plans contemplate extensive development work to be undertaken as early in the spring as weather conditions will permit, to open up new bodies of known ore of a grade that will yield a reasonable profit. With the ore derived from these sources, combined with the ore already developed in our present workings, we will be able to mine a sufficient tonnage to keep the mill operating at full capacity. During this period of development, the mill, which has been in continuous operation since started in 1911, will receive a general overhauling and will be improved materially. The present Chilean mill will be replaced with a ball granulator similar to the one installed a few years ago. Zinc-dust precipitation will replace the present zinc-shavings method. Increased capacity will be obtaind by installing intermediate crushing, and placing trays in the present Dorr thickeners. Other minor alterations will be made to thoroughly modernize the plant in accordance with the best cyanide practice."

Gold Feather Mill in Black Hills Has Been Started

The 100-ton cyanide plant of the Gold Feather Gold & Silver Mining Co., of Deadwood, S. D., started on Feb. 4. The plant was designed and constructed by A. N. Welton. Development during the past two years has blocked out a good reserve of ore.

British-Australian Broken Hill Company Is Financed

By Cable from Reuters to "Engineering and Mining Journal-Press"

Melbourne, Feb. 7—The North Broken Hill Co. and the Broken Hill South Co. each have taken up 50,000 shares at par in the British-Australian Broken Hill Co.

Witherbee, Sherman Co. Installs Liquid Oxygen Blasting Equipment

Mines at Mineville, N. Y., Will Have Plant to Make 75 Liters per Hour—Air Reduction Co. and Ingersoll-Rand Co. Co-operate in Introducing Process

A LIQUID OXYGEN EXPLOSIVES plant, one of the first to be installed underground, is being completed at the iron-mining property of the Witherbee, Sherman Co., at Mineville, N. Y. It will be put into active service in the mining operations of the company within a few weeks. This is the first commercial plant to be built by a newly formed organization, in which the Air Reduction Co. and the Ingersoll-Rand Co. will co-operate. The plant will have a capacity of 75 liters of liquid oxygen per hour and will be one of the largest single units ever constructed for this purpose.

Liquid oxygen has been employed in a practical way in a number of European and Mexican mines for some years. The imagination of engineers has been gripped by the statements that liquid oxygen in this field of usefulness has outstanding advantages because of its safety and its greater cheapness as compared with certain well-known commercial explosives. Naturally, many have wondered why manufacturers in the United States did not give attention to this matter and take active steps to bring about the introduction of liquid oxygen explosives in this country. As a matter of fact, the development abroad of blasting agencies of this sort was to a considerable extent forced upon the experimenters by reason of the comparative scarcity and the high price of forms of fixed nitrogen. This led to research by a French physicist, Georges Claude, who had previously given much study to the separation and the liquefaction of various gases. The Air Reduction Co. has for many years successfully exploited and used the Claude liquefaction processes in America.

Claude's intensive work has led to the development of a method for the manufacture of liquid oxygen which is claimed to be highly economical and efficient.

The results of Claude's research in liquefaction are said to be the basis of the process and apparatus that are being installed at Mineville, and that the Ingersoll-Rand and Air Reduction companies purpose to introduce elsewhere. They have completed arrangements to manufacture the equipment for preparing the liquid oxygen and for applying it to blasting in mine and quarry operations.

Governor Recommends Abolition of California State Mining Bureau

Sees Little Reason for Its Existence—University Should Have Exhibit—State Mineralogist Resigns

Governor F. W. Richardson, in his budget recommendations to the California State Legislature, now in session, recommends the abolishment of the State Mining Bureau. The part of the message referring to this subject is as follows:

"The State Mining Bureau has functions which overlap with other departments. In mining inspection the work of this bureau and the Industrial Accident Commission overlap. The oil work does not properly belong to this bureau. The mining exhibit should be made available for students at the University of California. I recommend that the oil department be turned over to the Surveyor General, and the inspection work be placed in the hands of the Industrial Accident Commission, that the mining exhibit be turned over to the University of California, and that the bureau be abolished."

Apparently the Governor was not clearly informed about the activities of the State Mining Bureau. The bureau performs no mine inspection and does not therefore overlap the field of the Industrial Accident Commission. The department of oil and gas of the bureau is concerned with the conservation of the oil and gas resources of the state and in the enforcement of certain work required to prevent the infiltration of water into the producing oil measures of the state. This work is of great importance to the petroleum industry. The department is self-supporting, a pro rata payment being made for its expenses by the oil producers of the state. The museum and library of the bureau is of public interest and use. Undoubtedly many would like to see the bureau reorganized, but some mining men question the advisability of its complete extinguishment. The resignation of Fletcher Hamilton, who, as state mineralogist, has directed the work of the bureau, exclusive of that relating to oil and gas, has been submitted to the Governor.

Export of Russian Iron and Manganese Ore Authorized

By Cable from Reuters to "Engineering and Mining Journal-Press"

Riga, Feb. 9—It is reported that the Plans Commission of the Russian Vneshtorg has authorized the export during 1923 of 7,500,000 poods (36 lb.) of iron ore and 3,000,000 poods of manganese ore.

Resumption Near Seneca, Mo.

John Hymer, Gus Mattes, and associates are opening up the old Oleson mine, near Seneca, about 13 miles south of Joplin, Mo. Recent drilling induced the activity. Other development work is also being done in this vicinity by small companies. There has been no mining near Seneca for several years.

Tri-State Zinc-Lead Miners Face New Tax Measures

Operators in the Picher zinc-lead district are worried by over-active legislators once more. In the Oklahoma Assembly several different measures have been introduced calculated to get more taxes from the zinc and lead producers. One measure, which it is feared has some chance of passing, would levy a tax on all orebodies in the ground, the operator being required to report accurately what his drilling development work has shown. Producers in the Oklahoma field already are laboring under an unusual burden of taxation. Besides a gross production tax they also have to pay an ad valorem tax. The portions of the three states, Oklahoma, Kansas, and Missouri, taken up by the mineralized area is so small that legislators representing other sections are overwhelmingly in the majority, and zinc and lead producers feel they are entirely too ready to try to get an undue proportion of the cost of government in the form of taxes from the mining industry.

First Dividend Paid by Chile Copper Co.

Contrary to expectations of Wall Street, the Chile Copper Co. declared its first dividend last week.

The amount was 62½c. a share on its 3,800,000 shares of $25 par value, outstanding. The dividend is payable March 22 to stock of record Feb. 2. There was no intimation in the official statement that the payments were to be continued quarterly.

Control of Chile, which until last month had been in the hands of the Guggenheims, was purchased by Anaconda Copper Mining Co. for a sum said to have been $77,000,000 for 2,200,000 shares. Shortly afterward Anaconda sold through a syndicate $150,000,000 in bonds to finance the purchase of Chile, retire some of its own bonds and to provide additional working capital.

Anaconda announced that the earnings of the Chile company would be more than enough to carry interest and all charges made necessary by the purchase.

Quarterly payments of 62½c. a share would be at the annual rate of $2.50, or enough to cover carrying charges. Only through the payment of dividends would the Anaconda stockholders be in a position to receive any direct return from the purchase of the South American property.

Bounty Stimulates Copper Mining in the Transvaal

Mining and smelting operations have been resumed at the Transvaal copper mines, owing to the offer of a bounty of £5 per ton for copper mined in the Union to be used in connection with the electrification of certain Natal railway lines, according to *Commerce Reports*. No copper was produced in the Transvaal from April to August, 1922.

News from Washington

By PAUL WOOTON
Special Correspondent

Joint Commission for Gold and Silver Inquiry Seems Assured

Thorough Investigation of Economics of Mining, Smelting and Marketing Metals Will Be Undertaken—Foreign Phases to Receive Special Study

A JOINT COMMISSION of Gold and Silver Inquiry is proposed in a resolution which has received the approval of the Senate Committee on Mines and Mining. The resolution was introduced by Senator Nicholson, of Colorado, and differs from his original resolution in that it embodies the improvements suggested during the course of the hearings. An identical measure has been introduced in the House by Representative Colton, of Utah. It is expected that the approval of the Committee on Mines and Mining of that body will be forthcoming promptly, so that the measure can be pressed in each house.

In the form approved by the Senate Committee on Mines and Mining, the joint commission is to consist of five Senators, three of whom are to be members of the majority party, and five members of the lower house, among whom the two parties are to be represented in the same proportion. The resolution provides that the commission is to investigate and report on the following subjects:

1. The causes of the continuing decrease in the production of gold and silver.

2. The causes of the depressed condition of the gold and silver industry in the United States.

3. The production, reduction, refining, transportation, marketing, sale, and uses of gold and silver in the United States and elsewhere.

4. The effect of the decreased production of gold and silver upon commerce, industry, exchange, and prices.

In addition, the commission is authorized to confer with citizens, associations or corporations of foreign countries with a view to the stabilization and wider use of silver in exchange and to propose to the President, or to the heads of executive departments, plans for negotiation with foreign governments, looking to the same end. The resolution specifically instructs the commission to recommend such legislation as may tend to remedy the existing conditions.

In support of the resolution, the committee put forward the following:

1. The production of gold and silver in the United States and throughout the world has been decreasing for a number of years.

2. It is the opinion of experts that many of the silver mines will be compelled to close down and cease operation upon the expiration of the Pittman Act, unless something is done to improve the condition of the industry.

3. Over 80 per cent of the silver of the world is produced in North America, and the major part of it is controlled by American citizens, yet the price of our silver is arbitrarily fixed by four London brokers, under support of the Bank of England.

4. Great Britain's control over the price and distribution of silver gives her an advantage in commerce in China and India.

5. Experts give it as their opinion that our export trade is adversely effected by the condition surrounding the production, marketing, sale, and use of silver.

6. There are many complex and disputed questions relating to the cost of production, reduction, refining, transportation, marketing, and use of gold and silver bearing upon the prosperity of such industries and the expansion of our trade.

The revised resolution follows the general lines of the proposals of the American Gold and Silver Institute, but also includes some of the original suggestions of the American Mining Congress. Each of these organizations has pledged its hearty co-operation, and it is probable that each will be called upon to assist the commission in an important way.

In commenting upon the introduction of the resolution in the Senate, J. F. Callbreath referred to the fact that the American Mining Congress at its convention last October in Cleveland adopted a resolution providing for appointment of a committee to study the silver situation and to the fact that members of this committee and himself as representatives of the Mining Congress had appeared before the Senate committee advocating a step such as contemplated by the Nicholson resolution. Members of the committee named as a result of the resolution adopted at Cleveland are: C. F. Kelley, president of the Anaconda Copper Co.; F. Y. Robertson, of the United States Smelting, Mining & Refining Co.; F. H. Brownell, vice-president of the American Smelting & Refining Co.; and Buleley Wells, of Denver, representing various western mining interests.

"The American Mining Congress will give all assistance possible to a commission as contemplated by Senator Nicholson's resolution," said Mr. Callbreath. "We feel that the commission will have a heavy task and an important one. It should be in a position to approach the foreign situation as no private study could hope to do.

"Restoration of the parity of money is essential to the economic rehabilitation of the world. Metallic money is the basis of confidence in the fiscal stability of any country."

H. N. Lawrie, managing director of the American Gold and Silver Institute, has been active in assisting members of the committee in its preliminary study of the bill.

Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended February 10 amounted to 648,000 oz. This brings the total purchases under the Pittman Act to 156,020,912 oz. and leaves about 51,000,000 oz. as the amount still to be purchased before the total quantity sold to Great Britain during the war is replaced in the Treasury. It should be noted that the quantities purchased in different weeks vary from 50,000 to more than 2,000,000 oz.

Treatment of Zinc-Retort Residues Will Be Studied by Bureau of Mines

Large tonnages of residues from the retort distillation of zinc ores, containing much unburned coal and several per cent of zinc as well as lead and silver, are now discarded as waste. Several methods have been proposed for treating these residues, and some are in use in certain places, especially where the residues contain lead and silver. A survey will be made by the Mississippi Valley Experiment Station of the Bureau of Mines of the processes which have been proposed and of those which are now in use for the treatment of this material, and data will be collected as to the tonnages available and typical analyses, both of currently produced residues and of those from past operations. The information collected should be of benefit to those in the industry who are working on this problem. If the survey indicates it to be advisable, experimental work will be initiated by the Bureau of Mines in an effort to develop some process to recover economically the valuable contents of these residues.

Mining Law Revision

Sentiment in Washington apropos of the revision of the mining law is gradually crystallizing in accord with the ideas of mining men. Majority opinion among those who desire revision now favors abolition of the apex law, according to Congressmen who have studied the situation, but with squares of 1,320 ft. by 1,320 ft. instead of the 1,500 ft. previously suggested. Majority opinion also favors amendment of the pending bill so as to relax the requirement for laying claims on absolute cardinal lines, so that approximate lines may be followed and the necessity for a prospector to be accompanied by a surveyor removed. Continuation of the requirement for annual work on claims and a limitation upon holding claims without development are generally favored.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Reef Deposits, Not Alluvial, Attract Russo-Asiatic People to Akim Properties

BY W. A. DOMAN

London, Feb. 2—An explanation of the sharp rise in Akim shares (West Africa), to which I made reference recently, is now forthcoming in an official circular. It appears that a number of quartz reefs with high gold content have been located on the company's properties. The existence of other reefs (perhaps covered by alluvial) is indicated by large pieces of quartz with free gold found in the alluvial during testing and hydraulicking operations. It is this particular factor which induced the Russo-Asiatic Consolidated to take an option to exploit the reefs. They do not presumably want the alluvial.

The "large pieces of quartz" are certainly impressive, and engineers are on their way to West Africa to make further investigations. Expert opinion is to the effect that a valuable reef deposit exists on the Akim Concession. It is generally believed that the managers of the Russo-Asiatic know more of conditions on the property than is indicated by the official circular, for they are reported to be still buying the shares.

A general impression prevails that West African gold mining companies will be given a "run." As a whole West Africa in recent years has proved disappointing from the mining standpoint, and the Consolidated Gold Fields definitely turned it down after being enthusiastic over the prospects. According to reports, however, further exploration is warranted. The Akim Concession also contains diamonds. Small stones only have so far been found, and it is said that the value of a carat's weight of them is about 20 to 25s. The company's gold concession aggregates about 20,000 acres and the diamond concession about 20 square miles.

It appears that a company called the Selection Syndicate, with which A. Chester Beatty is connected, at one time had an option over some Akim ground thought suitable for dredging, but no success was attained.

Having insufficient working capital when it ceased milling operations, in 1918, to carry on the development of its property on its own account, the Nigel Gold Mining Co. (South East Rand) entered into an agreement with its neighbor, the Sub-Nigel, to test the undeveloped deep-level ground. The work was so arranged that there was economy on the one side and valuable information gained on the other. Work progressed until January of last year, when, owing to the disturbances on the Rand, operations stopped for about five months. At the beginning of the week it was announced that the Sub-Nigel, in driving in Nigel ground, had met payable reef which for about 50 ft. averaged 21.66 dwt., over 42 in. Presumably owing to the necessity for condensation, the message is not quite clear. It is not certain, for instance, whether connection is made with the Nigel workings, or whether a new reef is cut. In any case the news is important, as both value and reef width are good. In its early days the Nigel worked ore of high gold content, but latterly values have run low, something over 6 dwt. As speculative things are in favor just now, Nigel shares were lifted right away from 5s. 6d. to 15s.

Johannesburg Letter

December Gold Mine Returns—Corduroy Substituted for Amalgamating Plates

BY JOHN WATSON

Johannesburg, Jan. 9—The following returns for December from the leading gold mining companies, have been published:

	Tons Crushed	Estimated Value	Working Costs per Ton Milled	Estimated Profit
Government Areas.....	137,000	£262,055	19s.2d.	£131,760
New Modder..	111,000	222,035	16s.6d.	130,440
Modder B....	62,000	145,279	20s.8d.	81,154
Crown Mines.	210,000	282,607	19s.11d.	73,103
City Deep....	90,000	175,665	23s.11d.	67,906
Modder Deep.	42,000	99,491	18s.9d.	60,177
Van Ryn Deep	55,800	114,856	20s.10d.	57,749
Springs.....	48,300	100,952	22s.4d.	47,656
Brakpan.....	60,200	109,500	21s.1d.	46,699
Randfontein Central....	171,500	211,086	20s.3d.	38,898
Modder East..	27,400	67,966	24s.1d.	34,908
Robinson Deep.....	73,400	100,863	.....	32,465
Geduld.....	46,000	75,796	19s.10d.	30,094
Meyer and Charlton...	15,700	38,790	19s.8d.	23,326
Langlaagte Estate.....	51,000	74,163	21s.4d.	20,136
Village Deep..	59,300	80,498	21s.9d.	16,073
Con. Langlaagte.....	45,500	57,372	20s.7d.	10,738
Van Ryn Estate.....	35,170	43,312	18s.11d.	10,056
Witwatersrand	45,200	49,721	18s.3d.	10,000
Con. Main Reef.....	50,000	77,669	27s.7d.	8,766
Rose Deep....	54,400	54,503	17s.0d.	8,288
Sub Nigel....	8,000	25,683	.....	6,860
Monrose Mines.....	45,500	62,193	24s.4d.	6,732
Robinson.....	14,500	20,791	19s.5d.	6,694
D.Roodepoort Deep.....	34,000	48,671	25s.3d.	5,727

The above profits are calculated on the realized net price of £4-5s per ounce of fine gold.

At Modder B, corduroy tables have been substituted for amalgamating plates. In this way, amalgam to the value of £80,750 have been released. This amalgam has accumulated over a long period, so the resultant gold is declared separately from the mine's monthly December output.

The Messina (Transvaal) Development Co., Ltd., will be prepared to supply copper ingots assaying 99 per cent from February.

Montreal Letter

Keeley Mines "Silver Slabs" in South Lorrain

BY ALEXANDER GRAY

Montreal, Feb. 8—After sixteen years of vicissitude that did not bring adequate return to owners, the Keeley property, in South Lorrain, the township adjoining Coleman in which Cobalt is situated, has disclosed a section of what is said to be the richest ore ever found in the mining area that has produced some remarkable bonanza ore. A solid "slab" extending from floor to roof, is said to be 12 ft. long and from ¼ to ½ in. thick; this on one wall and 5 ft. of ore on the other side of the drift, that is alleged to be 25 per cent metal, have made the Keeley the latest sensation and promises reward to the London owners who have persisted in their endeavors to make the mine reward their optimism and the judgment of J. Mackintoch Bell.

The Keeley was discovered in 1907, the coterie most active in the locality being Charlie Keeley, Robert Jowsey, Woods and others, who were largely instrumental in staking the Keeley, Little Keeley, Jowsey-Woods, Wettlaufer, Maidens, Haileybury Frontier, and Belle Ellen. Where Cobalt's bullion ores had created furore and furnished working capital by the car load—almost—it was not considered that Keeley's wire silver as a predominant feature was massive enough to suit the more exacting. What there was characteristic of Cobalt's halcyon days did not appeal to outright purchasers and promoters—so it remained for a "mining engineer," whose self-conferred degree was obtained in a Yukon blacksmith shop, to propose a deal.

Keeley, the discoverer, was the idol of the hour, for reasons which need not be explained. The price he stipulated, according to recollection, was $300,000. Dr. Beatty Nesbitt entertained the proposition. It happened, also, that Nesbitt, along with Wishart and Travers, had "framed up" the Farmers Bank of Toronto. Travers was general manager. He thought he saw an opportunity to acquire a fortune and at the same time rectify errors of omission and commission in the organization of his bank. The Keeley money was taken out of the bank by the trio named, London being enlisted incidentally.

During the Keeley negotiations, there was revelry by day and by night, in Toronto, and en route between Toronto and New York. Those familiar with what was transpiring were not surprised when the Farmers Bank went under, and two of the principal actors went to prison, the third declining to place himself within the jurisdiction of the court.

What work had been done on the Keeley was somewhat unimpressive—but the English interests took pride in having a gas producer, a 150-hp. gas engine, and extra special coal shipped all the way to South Lorrain.

The liquidator of the Farmers Bank made the best of it and disposed of the mine and plant to British shareholders.

It is they who hope to receive their shares when distributed by the British-Australian holding company this coming spring.

It is estimated that one shift can break down 140,000 oz. of silver in what is exposed, without seriously mutilating the showing. Whatever of fact there may be in this estimate, the possibility of producing five-ton lots worth $100,000 each has quickened the pace in South Lorrain, where the Mining Corporation of Canada and other Cobalt companies are operating. The Keeley, over and over again, was "lost and found." It has a substantial reserve of cash and silver. At one time, the Mines Finance Co., of New York—Messrs. Thompson, Lockhart, Farish, and others—had the Wettlaufer, in this neighborhood. The results were disappointing. Now Cobalt's refrain is "Silver Slabs Among the Gold."

ONTARIO

Continental Mines Finds Ore

A favorable impression has been created by the thoroughness with which President R. C. Warriner and his associates of New York have proceeded to prove their Kirkland Lake and Cobalt properties. Although the company was organized about six months ago, the discovery of an orebody on one of the central claims at Kirkland has resulted in developments of a most encouraging character. At outcrop this vein was 5 ft. wide and assayed $8. At 15 ft. the width was maintained and the value had increased to $9.60. Then another lead came into the shaft. It assayed $25.60. At and below 40 ft. the section has all the evidences of enrichment.

The shaft has reached a depth of over 50 ft. and sinking is proceeding, as rapidly as the facilities at hand permit. These disclosures, in the centre of the Continental area, a mile or more east of the Kirkland Lake producing area, have made the situation more interesting to those who have been seeking the direct eastern extension of the Kirkland Lake orebodies. At the Colonial mine, the Continental shaft should reach the contact during this month.

Tailings Disposal Difficulties Start Suit Against Dome Mines

The Digby Dome company, which owns 160 acres adjoining part of the holdings of the Dome Mines, Ltd., of Percupine, has entered an action against the Dome and asks an injunction to restrain the Dome from depositing tailings on the Digby ground. The situation is complicated by the fact that while an injunction might be operative against a company, nature will not pay any attention to one, and as long as the tailings flow from the mill and freeze in the winter time as they do, they will always flow on the Digby when the spring thaw comes. The Porcupine companies are finding the disposal of tailings an increasingly difficult problem, and the situation will become worse as time goes on. This is the first action brought in Porcupine, but it will probably not be the last.

BRITISH COLUMBIA

Trail Gets 10,505 Tons from Twelve Shippers

The Consolidated Mining & Smelting Co. received the following shipments at its smelter at Trail during the period from Jan. 22 to 31:

Name of Mine	Locality	Tons
Alamo Mill, zinc	Alamo, B. C.	58
Black Rock, zinc	Northport, Wash.	83
Henderson Group, zinc	Smither, B. C.	48
Knob Hill, zinc	Republic, Wash.	262
Krao, zinc	Ainsworth, B. C.	23
Lone Pine, zinc	Republic, Wash.	172
Paradise, zinc	Windermere, B. C.	77
Quilp, zinc	Republic, Wash.	115
Silversmith, zinc	Sandon, B. C.	43
Silversmith, lead	Sandon, B. C.	212
Steel Group, zinc	Brisco, B. C.	31
Surprise, zinc	Republic, Wash.	150
Company mines, zinc	Republic, Wash.	9,231
Total		10,505

CALIFORNIA

California Legislators Try Hands at Framing Mine Laws

San Francisco Correspondence

Copies of three mine safety bills, submitted to the present California Legislature, have been issued. One bill requires mines deeper than 1,000 ft. to make connections on their working level to an adjoining mine within 1,000 ft. of the mine in question. The advisability of connecting contiguous mines is seriously questioned by many, as it involves an inequity in many instances and in most cases does not materially increase the degree of safety. Mining men object to this proposed law, as in their opinion existing mine safety orders fully cover the question.

The wharf at Hyder, Alaska

ALASKA

Good Ore in Fish Creek Mine

Grant Mahood, president of the American Mining & Milling Co., says that a splendid body of ore has been uncovered in the 80-ft. tunnel at the company's Fish Creek mine, about eight miles from Hyder. In the face of the tunnel the lode is 9 ft. wide, and it holds this width in a 40-ft. raise that has been put up from the tunnel. Assays from careful samplings in the tunnel and raise have given an average of $107 per ton in silver and gold. The company expects to ship a considerable tonnage of ore over the snow during the winter and will in the meantime continue active development.

New Officials Will Be Approached on Tin Subsidy for Cornwall

It is reported that fresh efforts are about to be made to induce the British Government to come to the assistance of the Cornish tin mines, according to a dispatch to Reuters from London. A sub-committee of the Non-Ferrous Mines Committee, set up by the late government, failed to obtain a promise of Government assistance from the Chancellor of the Exchequer, but it is hoped to approach his successor, Stanley Baldwin, with greater chance of success.

The second proposed law provides for the establishment of two mine rescue stations centrally situated in the several mining districts of the state at the joint expense of the state and the mine operators. The mine operators are to form an organization and to provide a suitable place for housing the station and funds to defray the expense of a foreman or caretaker. Expenses of the rescue station other than for the purchase and installation of its equipment are to be borne by the mine operators. A $10,000 appropriation is provided. The appropriation suggested is meager for the purpose. The idea of rescue stations is excellent. It is probably the only way in which mine rescue organizations can be maintained.

The third proposed law amends the two-exit law that has been on the statute book since 1872. It provides for two means of egress for mines deeper than 300 ft. Noncompliance with the act is a misdemeanor punishable by fine and imprisonment. The proposed law adds nothing in effect to what already appears in the mine safety orders.

This activity on the part of the legislators is a consequence of the fatal Argonaut fire last summer. The laws seem to be adequate; the need is for efficiency in the Industrial Accident Commission, which is supposed to enforce them.

WASHINGTON

Admiral Strikes Copper-Silver Ore

The Admiral mine, near Valley, has encountered a full face of ore on the 500 level, according to reports of J. R. Brown, manager. A sample taken of the ore sorted for shipment shows of 11 per cent copper and 17 oz. silver. A raise will be started on the ore to the 200 ft. level, and, when completed, arrangements have been made to begin shipping. The Admiral mine has been undergoing development work for several years.

Silver Ore Will Be Cyanided at Deer Trail Mine

The old Dear Trail mine, 26 miles west of Springdale, in the Cedar Canyon district, has recently been bonded by Spokane mining men, including J. L. Magney and B. Diehl, of the U. S. Metals Co. They operate the Bay Horse mine, with their associates. The Deer Trail mine produced about $3,000,000 in high-grade silver ore in the early 90's. Dumps now on the property contain about 75,000 tons of 11 oz. silver ore as well as stope fillings and standing ore of higher grade. Plans of the new company include a new concentrating mill and extended metallurgical investigations, indicate cyaniding to be practical. The isolated situation of the district has held back development for a great many years. No details of the transaction have been made public.

Copper Ore Opened

The Consolidated Copper Co., about one mile north of the Deer Trail mine, has encountered 3 ft. of high-grade copper sulphide ore on the lower level. The shoot encountered is exposed in the level 100 ft. above, and shipments will be made in the spring, according to reports of V. W. Brasch, the manager.

NEVADA

Tonopah-Divide Will Ship Dump Ore to Realize $1 on Silver

The Tonopah-Divide Mining Co., at Divide, has finished repair and timber work on the 1,400 level and has resumed crosscutting toward the vein. The country rock shows increasing mineralization and silicification, which is regarded as an evidence of nearness to the vein. This company is preparing to take advantage of the present high price of silver and ship the dump ore, amounting to about 8,000 tons of $12 ore. An 80-ft. level from the main shaft is being established, and a short crosscut and raises will make cheap handling possible.

Leadville Mines Will Sink to 600 Ft.

The shaft of the Leadville Mines Co., producers of lead and silver, and operating 40 miles north of Gerlach, is to be sunk an additional 200 ft. to the 600 level. Developments on the 400 level were gratifying, and a large body of ore containing 30 oz. silver per ton was blocked out. If the ore continues to improve with depth it is probable that the company will make a change in the scale of its operations.

Pioche Ore Shipments

The Virginia Louise Development Co., which has taken over the Virginia Louise mine under bond, will begin shipments soon. The contract with the U. S. Smelting Co. calls for immediate delivery of ore, but, the mine having been closed down for over a year, resumption entails considerable work, both in the overhauling of the machinery and repairing underground. James Quirk, under whose management the Prince mine paid handsome dividends, has been engaged as superintendent and is now directing the preliminary work. The Combined Metals joins the shippers. Two cars of silver-lead-zinc ore have been consigned to the smelter. Shipments for the week ending Jan. 31 follow: Bristol Silver Mines Co., 525 tons; Prince Consolidated Mining Co., Bullionville tailings, 670; Dry Valley tailings, 450; Combined Metals, Inc., 105 tons; a total of 1,750 tons.

IDAHO

Cynide Company Will Develop Hydro-Electric Power

The Cynide Mining Co., operating the old Buckhorn mine, near Bonners Ferry, is putting in an arch concrete dam on the Moyie River. The dam will be about 75 ft. long and 45 ft. high and will utilize the total flow of the river to generate at low water about 600 hp. The power generated will be transmitted to the mine and mill, a distance of 11 miles. According to reports of J. Lafountaine, a new vein, 5 ft. wide carrying $12 to $20 in gold and 12 oz. in silver, has been discovered on the property.

Continental "Bucks" Snow With Caterpillars

The Continental mine, 26 miles west of Port Hill, is operating at full capacity with 150 men on the payroll. Despite the heavy snowfall and low temperature, caterpillar tractors are bucking the drifts and landing every week at Port Hill three carloads of concentrates, which are shipped to the Bunker Hill smelter.

Callahan Starts Systematic Exploration of Its Property

The Callahan Zinc-Lead Co. has started development which it hopes will make a substantial addition to its ore reserves. It was with this in view that Walter Harvey Weed, of New York, mining engineer and geologist, made an examination of the mine, and the work now being undertaken is in accordance with his recommendations. The first step was taken on Feb. 1, when a crosscut was started from No. 4 or the main operating tunnel. The crosscut will be extended 2,500 ft. south to the side line of the company's property. This is being done with the expectation of cutting one or two parallel veins which may prove productive. The company is also doing important exploratory work on the Galena, now owned by the Callahan company, and which was also recommended by Mr. Weed.

OREGON

Azurite Mill Make Good Flotation Concentrate

The Azurite Mining Co., operating the Azurite mine, on the Snake River, near Homestead, has developed 50,000 tons of ore above the 400 level which averages 2 per cent copper, 16 oz. silver, and 15 per cent zinc. Some high-grade ore running as much as 160 oz. silver to the ton has recently been encountered on the 400 level, according to I. W. Anderson, of Tacoma, Wash., who is heavily interested in the property. The mine has recently been equipped with a concentrator, and shipments have been made to the Tacoma smelter. The last carload flotation concentrate ran 160 oz. silver, 10 per cent copper, and 27 per cent zinc.

MONTANA

Manganese Mining Resumed at Philipsburg

The Philipsburg Mining Co., of Philipsburg, has recently closed a contract with the National Carbon Co. for a large tonnage of manganese dioxide ore. To meet the requirements of this contract it will be necessary to add two units of electrostatic separators and a drier to the present equipment. The new equipment and necessary building alterations will cost approximately $65,000. This work is now in progress. The revival of the mining of manganese ores in this district, which, by the way, was a large manganese producer during the war, and a silver producer for many years, will make it the most active small mining district in the state.

Butte-Jardine Operates Champion Mine Steadily

At the annual meeting of the Butte-Jardine Metal Mines Co. held in Butte recently, W. H. Hall, an old-time mining man of Montana, but now residing in Washington, D. C., was elected president. Reports were read relative to operations of the Champion mine and mill, which the company is now operating. Extensive mine development is being done and regular ore production is being maintained. It is reported that the mill recovery is about 90 per cent. The Champion, which is about 20 miles northwest of Butte, was a big silver producer of the early days. Prior to the reopening of this mine by the present company two years or so ago, it had not been worked to any extent for about twenty years.

Butte Production Increases

The Anaconda mines at Butte are running close to normal; 17,000 tons of ore was treated daily during January in the Washoe smelter at Anaconda, the greater part of which came from its own mines.

The Emma mine, owned by the Butte-Copper & Zinc Co., and under lease to the Anaconda company, produced 6,000 tons of zinc ore and about 250 tons of high-grade manganese ore in January of this year.

The zinc ore averages 13 per cent zinc, 5 oz. silver, and 4 per cent lead.

The Davis-Daly Copper Company mined about 25,000 tons of ore at its Colorado and Hibernia mines in January, regardless of the federal injunction which stopped both the Davis-Daly and Anaconda companies from mining in the area involved in apex litigation recently started.

The Elm Orlu, Butte & Superior, North Butte, and East Butte companies have increased their tonnages about 20 per cent in the last two months.

UTAH

Salt Lake Insecticide Co. Starts Plant

An interesting new industry is being developed in Salt Lake City by the Salt Lake Insecticide Co., which will manufacture insecticide to be used in combating the boll weevil, which is causing serious damage to the cotton and alfalfa crops. The raw material for the product is furnished by the arsenical ores of the Western Utah Copper mine near Wendover, in Box Elder County, where a large supply is available. The plant is now employing fifty men, and it is expected to enlarge it, as there is an increasing demand for the product. The process used is the invention of Frank D. Cameron, of Salt Lake. Cameron is general manager; T. H. Tarbox, is president; F. G. Rowley, treasurer, and George R. Ramsbottom, secretary. All three are of Pawtucket, R. I.

Vipont Silver Ships Steadily

The mill of the Vipont Silver Mining Co. in Baxelder County is treating 200 tons of ore daily, and sending its ores and concentrates by sled to the loading station at Oakley, Idaho. Road conditions, owing to heavy snows, are excellent for this method of shipment. During recent months repairs have entirely done away with power shortage due to troubles in the transmission line.

Columbia Steel Corporation Will Sell Bonds in Utah

The Columbia Steel Corporation, which is making an issue of $4,000,000 worth of 15-year first mortgage bonds, has received permission from the state securities commission to sell $185,000 of the issue in Utah. These bonds are being placed for sale with various brokerage firms. The Columbia Steel Corporation is seeking to exploit the iron and coal fields of southern Utah, and to build up a steel industry in the state. It is proposed to build pig-iron furnaces and a by-product coke plant along the shores of Utah Lake half way between Springville and Provo, in Utah County.

Tintic Standard Breaks Production Record

The Tintic Standard is producing from all levels, from the 1,450 to the 800. About half of the output is going to the mill. In January, 12,400 tons were produced, and this is stated by officials of the company to be the heaviest tonnage for any month in the history of the mine. Also, the grade of the ore has been higher. Development work is being done on some levels under contract, and this method of work is said to be giving good results.

ARIZONA

Steam Shovels Ready to Start on Sacramento Hill

Resumption of steam-shovel mining operations on Sacramento Hill by the Copper Queen Branch of the Phelps Dodge Corporation awaits completion of preparatory work. A large force of men has been placed at work overhauling and repairing the steam-shovel and railway equipment.

G. H. Dowell, manager, announces that the first unit of the new 4,000-ton concentrating mill at Warren will be placed in operation about May 1, 1923, and will be followed by the other three units at intervals of about two weeks each. It is planned to have all four units in operation by July 1. Prior to the suspension of steam-shovel operations on Nov. 1, 1921, sufficient ore was developed on Sacramento Hill to assure a continuous ore supply for the concentrator.

C. B. Clyne, who supervised the construction of a 4,000-ton concentrator for the Moctezuma Copper Co. of the Phelps Dodge Corporation, at Nacozari, Sonora, Mexico, has arrived in Bisbee and is directing the large force of men who are working to complete the new mill and place it in readiness for operation.

JOPLIN-MIAMI DISTRICT

Two More New Mills Under Way

The Heffernan Mining Co., composed for the most part of the same people who operated the Montreal mine, at Douthat, Okla., for the last six years, is building a new mill on a tract in Kansas, northwest of Picher, Okla. It adjoins the tract where T. F. Lennan, of Joplin, with eastern associates, is building a new mill on the Chubb tract. The Lennan mill will be ready for operation within a week or two, as the water has been drained from the land in this immediate vicinity. The Heffernan mine will not be ready to produce for five or six months. C. F. Dike, of Joplin, is the manager in charge.

Wentworth—Old Camp—Being Revived

Resumption of zinc mining in the old camp at Wentworth, Mo., is assured by recent developments. The Boyd-Wilson Mining Company resumed operation on the Barnett land some weeks ago, and now a new company, represented by P. E. Tabor, of Joplin, as trustee, has purchased the 250-ton mill with 160-acre fee of the Gobler property, on the eastern edge of the town. Unwatering already has been started by this company, which expects to have mine producing in about thirty days. It was last operated by the East Hampton Zinc Corporation. A company of St. Louis investors also has recently leased the Lang property, and is unwatering it preparatory to the erection of a mill.

MICHIGAN

C. & H. Conglomerate Rich at 8,100 Ft. Electrolytic Treatment of Copper Discontinued

The conglomerate lode of Calumet & Hecla, at Calumet, shows no diminution in richness at depth. New drifts opened on both sides of No. 7 shaft at a depth of 8,100 ft. are in copper rock fully as rich as in the upper levels. This shaft is bottomed at the 83d level and drifting in the two lower levels will be started as soon as the timber is installed. Stoping is in progress from the 73d to the 77th level of No. 6 shaft. No other new ground is being opened in the south branches of the conglomerate department, but in the north end new openings are proceeding in Tamarack Junior territory. Removal of backs of old stopes and arches is proceeding in six of the conglomerate shafts, all of this rock running high in mineral content. Calumet & Hecla has discontinued the electrolytic treatment of its copper, at least temporarily. A change in refining methods, involving cleaner skimming, has reduced the silver in the copper to only a small amount, making electrolytic treatment unnecessary.

MINNESOTA

New Marion Shovel for Sagamore Pit

At Riverton John A. Savage & Co. has ordered a 300-ton Marion electric shovel for use in loading ore at its Sagamore open pit. The shovel will have Ward-Leonard d.-c. control and will be equipped with a 90-ft. boom and 6 cu.yd. dipper. Delivery is to be made in June. Six additional 20-cu.yd. stripping cars have been purchased from Kilbourne-Jacobs Co. The Savage company also plans the purchase of several locomotives, but has not decided between steam or electric locomotives.

The Sagamore mine [illegible] the largest producer of manganiferous [illegible]s in the country. Shipments for the year ended Jan. 1 totaled 197,449 tons. Ore was shipped over the Northern Pacific R.R., 4,000 tons all-rail, the rest by boat to Lower Lakes. A large part of the output was treated in the recently completed drying plant, which handles 3,000 tons per day.

At Crosby, shipments from the Cuyuna Range for 1922 amounted to 1,496,585 tons, an increase of 1,006,000 tons over the amount shipped in 1921. The Inland Steel Co. was the largest shipper, with a total production of 360,520 tons. Shipments from its individual mine were as follows: Armour No. 2, 319,353; Armour No. 1, 9,359; Wearne-Thompson, 31,808.

A healthy increase in the production of manganiferous iron ore grades is noted in the last season's shipments. A total of 630,846 tons was shipped, being more than ten times the amount of these ores produced in 1921, as well as the largest amount ever shipped from the Cuyuna, with the exception of the record made in 1918. The bulk of last season's manganiferous production is credited to three open pits, the Sagamore, Mahnomen, and Portsmouth.

THE MARKET REPORT

Daily Prices of Metals

Feb.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
8	14.75	39.00	40.25	8.05	8.00@8.15	6.85@7.05
9	14.75@14.875	39.25	40.375	8.05	8.00@8.15	6.85@7.05
10	14.875	39.25	40.75	8.05	8.00@8.15	6.85@7.05
12	.....	.....	.....	....	.....	.....
13	14.875@15.00	40.25	41.25	8.05	8.00@8.15	6.90@7.10
14	15.00	40.00	41.00	8.05	8.00@8.15	6.95@7.15

*These prices correspond to the following quotations for copper delivered: Feb. 8th, 15c.; 9th, 15@15.125c; 10th, 15.125c.; 13th, 15.125@15.25c.; 14th, 15.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
8	65½	66¼	72¼	184¼	186	28⅝	27¾	34⅞	34⅛
9	65⅝	66⅜	72½	184¾	186½	28¼	27⅞	34¾	34⅛
12	65¾	66½	72½	186⅝	188	28⅜	27⅞	35⅛	34⅛
13	65⅞	66⅝	72¾	186¾	188⅜	28⅜	28	35⅛	34⅝
14	66¼	67	72¼	186⅜	188¼	28⅜	28	35¼	34⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver			Feb.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
8	4.67	99⅝	63⅝	30½	12	.....	...	...	30 15/16
9	4.67⅜	99⅝	64	30¾	13	4.68½	99⅝	63⅞	30¾
10	4.68	99⅝	63¾	30 11/16	14	4.67⅜	99⅝	63⅞	30 11/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Feb. 14, 1923

Metal consumers continue extremely active, and all metal sellers are highly optimistic of the future. Every week sees further expansions indicated, and it is hard to see why the current year will not be a banner one for practically all non-ferrous metals. Most of the activity is confined to domestic business, but it is felt that a corresponding foreign demand for metals, although likely to be delayed longer than was expected, is nevertheless sure to develop. This foreign demand may finally arrive just in time to take up any slack in domestic business. The copper market at last seems to be permanently on the upgrade; lead is as strong as ever; tin is advancing again; and zinc has again taken a turn for the better.

Copper

Copper has shown surprisingly little tendency to linger at the 15c. delivered level, which was supposed to be rather of a stumbling block. Since Friday no copper has been obtainable at that price unless the consumer was extremely favorably situated, and yesterday and today the 15¼c. level has been passed, with sales of appreciable volume at 15.25c. Several offers of 15½c., made yesterday afternoon, apparently went without being accepted. Sellers are not anxious to sell further ahead than April without getting a premium, as they feel that the price tendency will continue upward. At the same time, many producers are well sold ahead for the next three months, so the situation is fundamentally sound. Refinery deliveries in January were well over 200,000,000 lb., and are said to have been, with one exception, larger than those of any other month since the war.

The telephone and telegraph and electrical industries generally continue extremely active and are taking extraordinarily large tonnages of copper. Export demand has continued satisfactory, though Germany is temporarily out of the market. Should this latter condition continue, it is felt that increased buying by fabricators in other countries will take the place of the former demand by Germany. Export prices have followed domestic prices upward during the week, and at current levels net domestic producers the same or slightly more than is obtained for American business.

Lead

The official contract price of the American Smelting & Refining Co. continues at 8c., New York.

The lead situation is much the same as it has been for the last two or three weeks. Most of the demand in the New York market has been met at the 8c. level of the principal interest, but some tonnages of fair size have been sold for 8.15@8.20c., and shipments of chemical lead from the West have been booked at the full freight differential over the St. Louis market. The 8.05c. price which we quote represents a weighted average of sales of grades on which no premium is demanded. There is no great stringency of near-by lead, supplies having been augmented to a large extent by importing Mexican lead, but the market continues exceedingly firm. All consuming industries continue exceedingly active, and there is no sign yet of a lull in the demand.

The St. Louis market continues somewhat above that at New York, with supplies scanty, particularly of chemical lead, which is commanding a premium of about 10 points. Chicago prices are on about the same level as those at St. Louis, with Pittsburgh, Buffalo, and other intermediate points compelled to pay a premium over either New York or St. Louis prices.

Zinc

The market has shown more activity than for several weeks, and prices have advanced. The wide difference in the price of prompt and future shipment metal is still noticeable. Prompt metal

can be obtained for 7.15c. per lb., whereas zinc for delivery in April is 6.95c. The statistics of the American Zinc Institute for January show an increase in production and a decrease in stocks. Stock on hand Jan. 1 was 18,252 tons; production, 46,317; shipments, 47,995; stock on hand Jan. 31, 16,574 tons; shipped for export during January, 7,954 tons. Export business was an important factor in decreasing stocks. Without it, they would have risen in amount. High-grade zinc is still being sold for 7.75@8.25c. per lb. with usual freight allowances, but producers are well sold.

Tin

Consuming demand has continued very good, with plating interests buying tin in sizable quantities. Prices continued upward in London, and, with business active here, there is no difficulty in reflecting the advance locally. Tin for forward delivery is quoted at the same prices as are asked for spot.

Arrivals of tin, in long tons: Feb. 9th, Straits, 25; 10th, Straits, 300; Australia, 20; 13th, Straits, 750; China, 150; London, 75. Total so far in February, 2,555.

Gold

Gold in London: Feb. 8th, 88s. 4d.; 9th, 88s. 1d.; 12th, 87s. 11d.; 13th, 88s. 1d.; 14th, 88s. 1d.

Foreign Exchange

Sterling has changed but little from last week, but francs and lire are somewhat weaker. Tuesday, Feb. 13, cable quotations on francs were 6.1075c.; lire, 4.81c.; marks, 0.0038c.; and Canadian dollars, 1⅛ per cent discount.

Silver

The market has held steady the last week, with an increased demand for silver and a scarcity of offerings on any decline. There is some difference of opinion as to whether the China New Year holidays and the subsequent period of dullness will cause a decline in price, but as these holidays began on Feb. 15, their effect, if any, will soon be felt.

Mexican Dollars—Feb. 8th, 48½; 9th, 48¾; 10th, 48⅝; 13th, 48¾; 14th, 48¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 24c. per lb.; 98 per cent, 23@23.5c. London quotations, £90@£100.

Antimony — Chinese and Japanese brands, 7½c. W. C. C., 7⅞@8¼c. Cookson's "C" grade, spot, 8¼@8¾c. Market quiet.

Bismuth—$2.55 per lb. London quotes 10s.

Cadmium—$1.15 per lb. London quotes 4s. 6d. @ 5s. 6d.

Iridium—$260@$275 per oz.

Nickel—25@30c. per lb. for 99 per cent virgin metal.

Monel Metal—Shot and blocks, 32c. per lb.; ingots, 38c.; f.o.b. W. Va.

Osmium—$80@$85 per oz., Los Angeles. Supply scarce.

Palladium—$79 per oz.

Platinum—$116 per oz.

Quicksilver—$71 per 75-lb. flask. San Francisco wires $68.65. London £10 10s.

Selenium—$2 per lb.

The prices of **Cobalt, Molybdenum, Radium, Rhodium, Tellurium** and **Thallium** are unchanged from prices given Feb. 3.

Metallic Ores

Chrome Ore—Indian chrome ore, $19 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, $24 per ton. Market quiet.

Manganese Ore—33c. per long ton unit, seaport, plus duty. Chemical ore, $75@$80 per gross ton.

Molybdenum Ore—65@70c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates.

Tungsten Ore — Wolframite, $8; scheelite, $8.50@$9 per unit of WO_3, f.o.b. New York.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published Feb. 3.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 10—Zinc blende, per ton, high, $44.90; basis 60 per cent zinc, premium, $42; Prime Western, $41; fines and slimes, $40@$37; average settling price, all grades of blende, $41.96; calamine, average price, $24.97 per ton of 40 per cent zinc.

Lead, high $108.60. Neither buyers nor sellers would give out a basis price for today's offerings, but it is known $106 was offered, and it may touch a still higher level. Secrecy would indicate a $107.50 to $110 possible market.

Shipments for the week: Blende, 12,301; calamine, 195; lead, 1,593 tons. Value, all ores the week, $683,170.

Buyers contracted for upward of 17,000 tons of zinc blende today, a considerable portion of which is unproduced. Buyers for the new Lanyon smelter and for the Ozark Oxide company, the latter of Coffeyville, Kansas, gave an added demand of almost 1,000 tons.

Platteville, Wis., Feb. 10.—Blende, basis 60 per cent zinc, $44 per ton. Lead, basis 80 per cent lead, $107 per ton. Shipments for the week: Blende, 332 tons; lead, none. Shipments for the year: Blende, 4,335; lead, 80 tons. Shipments for the week to separating plants, 675 tons blende.

Non-Metallic Minerals

Feldspar—No. 1 pottery grade, $6@$7.50 per long ton; No. 2, $5@$5.50; f.o.b. North Carolina points. No. 1, $7.50; No. 2, $6.50; ground, 60 to 80 mesh. $18@$20 per short ton; 120 to 150 mesh, $20@$24; 200 mesh, $25@$30, f.o.b. Connecticut points. No. 1, Canadian, $25 per net ton, f.o.b. Ohio mills.

First quality ground, $19 in New Hampshire, $18 in Maine; second quality, $16 in New Hampshire. In Colorado, No. 1 crude, $5; No. 2, $4.50 per short ton.

Asbestos, Bauxite, Barytes, Chalk, China Clay, Diatomaceous Earth, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and **Tripoli** are unchanged from the Feb. 3 prices.

Mineral Products

Arsenious Oxide (white arsenic)—14@14.50c. per lb.

Nitrate of Soda—$2.60 per 100 lb.

Potassium Sulphate, Copper Sulphate and **Sodium Sulphate** are unchanged from quotations of Feb. 3.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $102.50@$107.50 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $37, f.o.b. furnace; 16@19 per cent, $36.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published Feb. 3.

Metal Products

Copper Sheets—Base price, 22¾c. per lb. Wire, 17¾c.

Yellow Metal — Dimension sheets, 20.50c. per lb.; rods, 17.5c. per lb.

Zinc Sheets, Lead Sheets and **Nickel Silver** are unchanged from the prices published Feb. 3.

Refractories

Bauxite Brick, Chrome Brick, Chrome-Cement, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the Feb. 3 prices.

The Iron Trade

Pittsburgh, Feb. 13, 1923

In point of tonnage, the turnover in finished steel products is lighter than in January or December, but the market is stronger. There is a general rising tendency in steel prices. Advances have occurred since the first of the year in bars, shapes, plates, wire and pipe. Nails have been advanced, since the first of the year, by independents only, and the independent market on sheets is now advancing about $5 a ton, the Steel Corporation not being a factor, as it is already sold on sheets into or through June.

The Steel Corporation's unfilled obligations increased by 165,073 tons in January, against a decrease of 94,539 tons in December.

Steel ingot production increased sharply in January, to a rate of about 43,500,000 tons a year, against a rate of about 40,000,000 tons in the last three months of the old year. Production will continue increasing until labor shortage becomes a restrictive influence with the resumption of out door work on a larger scale than last fall.

Pig Iron—The market continues dull but firm, at $27.50@$28 for bessemer, $25@$26 for basic and $27@$28 for foundry and malleable, Valley, with $1.77 freight to Pittsburgh.

Connellsville Coke — Market easier, due to decreasing domestic demand; furnace, $7@$7.50; foundry, $8@$8.50.

Facts for the Stockholder

VI—New Jersey Zinc Co.

THE NEW JERSEY ZINC CO. was incorporated in New Jersey in October, 1880, as the New Jersey Zinc & Iron Co., and assumed its present name in 1897. It owns the well-known zinc mines at Franklin, N. J., and the entire capital stock of the following subsidiaries: the New Jersey Zinc Co. of Pennsylvania, with plants at Palmerton and Freemansburgh, Pa.; the Mineral Point Zinc Co., with mines near Benton and Highland, Wis.; the Empire Zinc Co. of Colorado, with mines in Colorado, New Mexico, Arizona, and Nevada; the Empire Zinc Co. of Missouri; the Prime Western Spelter Co.; and the Bertha Mineral Co. It also owns mines at Iola, Kan. Its ore reserves are reported to be equivalent to over a thirty years' supply at the present rate of production. Its annual smelting capacity is now said to be over 160,000,000 lb.

The properties of the Mineral Point Zinc Co. include the Black Jack, at Galena, Ill.; the Croker, at Livingston; the Highland, at Highland; the Kennedy, at Hazel Green; and the Pennsylvania and Hoskins mines, at New Diggings, Wis. Equipment includes concentrating, roasting, magnetic separating, zinc oxide, and acid plants.

The Empire Zinc Co. of Colorado owns the Eagle mines, at Gilman, with reserves estimated at 2,000,000 tons of 15 per cent zinc ore, and a 150-ton roasting and magnetic separation plant, the Small Hopes mine, at Leadville, and the Cañon City mill and ore testing plant, at Cañon City, Colo.; the Kelly mine and other properties at Kelly, N. M., equipped with a 100-ton concentrator; the Cleveland mine, near Silver City, N. M., with a 125-ton magnetic separation plant; the Hanover and Republic mines, at Hanover, N. M., equipped with a 125-ton magnetic separation plant; the San Xavier mine, south of Tucson, Ariz.; and the Potosi mine west of Arden, Nev.

The company is engaged in the manufacture of spelter, including the well-known Horsehead brand, which is made from the high-grade ore of the Franklin mine; zinc sheets, zinc plates, zinc dust, zinc oxide, zinc chloride, ocher, spiegeleisen, sulphuric acid, and lithophone. The capacity of its lithophone plant was doubled during 1921.

The original capital of $3,000,000 was increased to $10,000,000 in 1897, to $35,000,000 in 1915, by the payment of a 250 per cent stock dividend, and on May 12, 1920, the authorized capital was increased to $50,000,000, of which $45,466,400 is now outstanding, divided into 454,664 shares of a par value of $100. The stockholders authorized a plan whereby $7,000,000 of the increased capital was distributed as a stock dividend, $7,000,000 was offered to stockholders for subscription at the rate of one new share for each five shares held, and $1,000,000 was offered to employees for subscription at par. Funded debt consists of $4,000,000 first mortgage 4s, due Oct. 1, 1926.

Earnings were high during the war period, net income being over $34,000,000 in 1916, $19,000,000 in 1917, and nearly $12,000,000 in 1918. During the past two years the net income is reported quarterly as follows:

Quarter	1921	1922
First	$204,345	$1,086,080
Second	583,927	1,586,645
Third	763,053	1,732,521
Fourth	654,697	1,638,835

The dividend record is noteworthy. Regular dividend distributions have been: 1907-14, 20 per cent; 1915, 15 per cent; 1916-20, 16 per cent; 1921-22, 8 per cent. Extra dividends have been paid as follows: 1907, 5 per cent; 1908-11, 10 per cent; 1912-14, 30 per cent; 1915, 42 per cent and 250 per cent in stock; 1916, 60 per cent; 1917, 30 per cent; 1918-19, 4 per cent; 1920, 20 per cent in stock; Jan. 10, 1923, 2 per cent. The present rate of the regular dividend is 8 per cent, payable quarterly.

The price range of the stock, which is traded in on the New York Curb Exchange, during the last two years has been: 1921, high 142, low 110; 1922, high 174½, low 124½; closing price Feb. 10, 1923, 170½. INVESTIGATOR.

Exports of Metals During December, 1921 and 1922

Exports of copper, lead, and zinc during December, 1922, with revised comparative figures for December, 1921, as compiled from the returns to the Bureau of Foreign and Domestic Commerce, are as follows:

Exports of Copper, Lead, and Zinc

In Pounds

	Dec., 1921	Dec., 1922
Copper		
Ores, concentrates matte, and regulus (copper content)	(a)	(a)
Copper and manufactures of (total)	.....	51,720,425
Unrefined, black and blister	(a)	(a)
Refined, in ingots and bars	58,524,588	44,499,459
Exported to:		
Belgium	3,322,453	2,319,632
France	8,807,022	10,547,505
Germany	20,971,010	11,690,117
Italy	2,220,952	4,788,129
Netherlands	4,474,097	2,623,732
Spain	640,062	1,515,252
Sweden	1,118,348	1,009,597
United Kingdom	1,176,815	8,123,139
Canada	17,736	651,943
China	3,696,000	448,000
Japan	11,759,781	.....
Other countries	320,312	782,413
Old and scrap	131,235	237,809
Composition metal, copper chief value	1,037	5,481
Pipes and tubes	62,200	157,619
Plates and sheets	293,031	254,902
Wire except insulated	374,262	757,610
Insulated wire and cable	.....	650,924
Lead		
Pigs and bars		
From domestic ore	1,985,816	2,021,367
From foreign ore	4,442,678	7,984,381
Exported to		
France	1,680,749	4,930,324
Germany	1,444,612	1,344,521
Netherlands	910,438	168,127
United Kingdom	1,668,715	2,464,940
Brazil	648,089	678,925
Japan	.....	44,140
Other countries	75,891	374,771
Zinc		
Dross	790,778	216,094
Spelter		
From domestic ore	865,484	4,775,537
From foreign ore	.....	3,783,476
Total zinc slabs and blocks	865,484	8,559,013
Exported to:		
France	504,103	1,220,680
United Kingdom	.....	6,527,289
Canada	311	104,333
Japan	112,045	.....
Other countries	249,025	706,711
In sheets and strips	322,645	900,787
Zinc dust	.....	706,506
Other zinc manufactures	.....	42,258

(a) None reported.

Upper Silesian Zinc Production Improving

SPECIAL CORRESPONDENCE

Charlottenburg, Jan. 27, 1923—The Upper Silesian zinc production is in course of promising development. The Giesche company is offering more plentifully ex Breslau. Consignments of this metal are quoted as a rule in terms of the mark. The Giesche mine is not only the most important zinc producer of Germany, but the managers are also at liberty to offer freely, that is, not through the hands of the three great merchant firms of Aaron Hirsch of Halberstadt, and the two Frankfort establishments, Beer, Sondheimer & Co., and the Metallgesellschaft. Another feature of the Giesche company is its independence of French and British capital participation, whereas other large members of the Zinc Syndicate, such as even Donnersmarck, Schlesischeidine (of Lipine), Hohenlohe, etc., have lost their independence irretrievably, as it would appear. The Hohenlohe concern has formed a new company that has been styled Oeringen Aktiengesellschaft, at Berlin.

The principal concern of the German metal trades is now that of a sufficient fuel supply. There is a stringent necessity to make up the shortage from the Ruhr by importing coal from England, but strong competition is met from Americans, Scandinavians, Italians, and even the French, so that the supply at the disposal of the German trades diminishes apace.

In recent months, the Soviet authorities have forwarded a great many obsolete warships to Germany for breaking up for scrap. Refineries have thus come into possession of fresh supplies of old metal, so that the prohibition of scrap from England and France would be well met but for the fuel stringency.

MINING STOCKS

Week Ended Feb. 10, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	59½	58	59	Dec. '22, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2¼	2	2¼		
Allouez	Boston	22	19	22	Mar. '19	1.00
Anaconda	New York	48¼	47½	48½	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3⅜	3 7/16	3⅜		
Ariz. Com'l.	Boston	8⅛	8	8¼	Oct. '18, Q	0.50
Bingham Mines	Boston	18	17½	18	Sept. '19, Q	0.25
Calumet & Arizona	Boston	56¼	54¼	55¾	Dec. '22, Q	0.50
Calumet & Hecla	Boston	300	298	300	Dec. '22, Q	5.00
Canada Copper	N. Y. Curb	*3	*2	*3		
Centennial	Boston	†10	†8	9	Dec. '18, SA	1.00
Cerro de Pasco	New York	45½	43⅜	43½	Mar. '21, Q	0.50
Chile Copper	New York	29⅞	29¼	29½		
Chino	New York	26½	25½	25⅝	Sept. '20, Q	0.37
Copper Range	Boston	38½	37	38	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅛	1⅛	1 1/16		
Davis-Daly	Boston	3	2½	3	Mar. '20, Q	0.25
East Butte	Boston	8¼	8	8¼	Dec. '19, A	0.50
First National	Boston Curb	43	40	40	Feb. '19, SA	0.15
Franklin	Boston	1⅛	1⅛	1⅛		
Gadsden Copper	N. Y. Curb	*70	*70	*70		
Granby Consol.	New York	26⅛	24	25½	May '19, Q	1.25
Greene-Cananea	New York	26	24	26	Nov. '20, Q	0.50
Hancock	Boston	2½	2½	2½		
Howe Sound	N. Y. Curb	3½	2⅞	3⅛	Jan '21, Q	0.05
Inspiration Consol.	New York	35⅝	33½	34½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	5½	5½	5½	Sept. '20, K	0.25
Isle Royale	Boston	23	21½	23	Dec. '22, K	0.50
Kennecott	New York	38⅜	36⅞	38⅜	Jan. '23, K	0.75
Keweenaw	Boston	1⅝	1⅛	1⅛		
Lake Copper	Boston	3¼	3	3		
Magma Copper	New York	32¼	30⅛	32	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2	1⅞	1⅞		
Mass Consolidated	Boston	1⅛	1⅛	1⅛	Nov. '17, Q	1.00
Miami Copper	New York	27⅛	27	27½	Nov. '22, Q	0.50
Michigan	Boston	2½	2	2½		
Mohawk	Boston	58	56	57½	Nov. '22, Q	1.00
Mother Lode Con.	New York	11⅛	11⅛	11⅛	Dec. '22, K	0.50
Nevada Consol.	New York	16	14⅜	15⅛	Sept. '20, Q	0.25
New Cornelia	Boston	18⅛	18	18⅛	Nov. '22, Q	0.25
North Butte	Boston	10	9⅛	9⅛	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*48	*45	*48		
Old Dominion	Boston	21	19½	19½	Dec. '18, Q	1.00
Osceola	Boston	31	30	31	Dec. '22, K	1.00
Phelps Dodge	Open Mar.	†175	†165		Jan. '23, Q	1.00
Quincy	Boston	36⅛	34	36⅛	Mar. '20, Q	1.00
Ray Consolidated	New York	14⅛	13⅛	14⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅛	1	1⅛		
St. Mary's Min. Ld.	Boston	42	40⅛	41	Apr. '22, K	2.00
Seneca Copper	Boston	9⅛	9⅛	9⅛		
Shannon	Boston	*75	*57	*75	Nov. '17, Q	0.25
Shattuck Arizona	New York	9⅛	9	9	Jan. '20, Q	0.25
South Lake	Boston	†*75	†*50	*50		
Superior & Boston	Boston	3	2⅞	3		
Tenn. C. & C. cfs.	New York	12⅛	11⅞	11⅞	May '18, I	1.00
Tuolumne	Boston	*64	*45	*62	May '13,	0.10
United Verde Ex.	N. Y. Curb	27⅛	27	27⅛	Nov. '22, Q	0.25
Utah Consol.	Boston	1⅛	1⅛	1 1/16	Sept '18,	0.25
Utah Copper	New York	66⅛	63½	65⅞	Dec. '22, Q	0.50
Utah Metal & T.	Boston	*99	*95	*98	Dec. '17,	0.30
Victoria	Boston	1⅛	1	1		
Winona	Boston	1	*85	1		
Wolverine	Boston	8⅛	7⅛	8⅛		
NICKEL-COPPER						
Internat. Nickel	New York	15⅛	14⅛	14⅛	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	76	74½	76	Feb. '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	5⅛	5⅛	5⅛		
National Lead	New York	132½	128	131	Dec. '22, Q	2.00
National Lead, pfd.	New York	114	112½	114	Dec. '22, Q,	1.75
St. Joseph Lead	New York	19⅛	18⅛	19⅛	Dec. '22, Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	17	15⅞	17	May '20,	1.00
Am. Z. L. & S. pfd.	New York	51	49	51	Nov. '20, Q	1.50
Butte C. & Z.	New York	11	10⅜	10⅜	June '18,	0.50
Butte & Superior	New York	32⅛	30⅛	31⅛	Dec. '22,	0.50
Callahan Zn-Ld	New York	12⅛	10⅛	11⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	172	170	170½	Feb. '23, Q	2.00
Yellow Pine	Los Angeles			*77	Sept. '20, Q	0.03
SILVER						
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*32½	*31½	*31½	May '20, K	0.03
Candelaria	N. Y. Curb	*32	*30	32		
Coniagas	Toronto	2.10	2.10	2.10	May '21, Q	0.12½
Crown Reserve	Toronto	*36	*34½	*35½	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb	1⅛	1⅛	1⅛		
Kerr Lake	N. Y. Curb	3¼	3¼	3¼	Jan. '23, Q	0.12½
La Rose	Toronto	*33	*32	*33	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*18	*18	*18	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.10	1.01	1.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6	5⅞	6	Jan. '23, Q, X	0.60
Ontario Silver	New York			5	Jan. '19, Q	0.50
Temiskaming	Toronto	*32	*31	*32	Jan. '20, K	0.04
Trethewey	Toronto	*5	*4	*5	Jan. '19,	0.05

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York			¼		
Alaska Juneau	New York	1⅛	1	1⅛		
Atlas	Toronto	*15	*13½	*13½		
Carson Hill	Boston	9⅛	8	8⅛		
Cresson Consol. G.	N. Y. Curb	2¼	2⅛	2⅛	Jan. '23 Q.	0.10
Dome Mines	New York	42¼	41⅛	42	Jan. '23, Q	0.50
Golden Cycle	Colo. Springs	*89	*88	*89	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	14.00	12.80	13.60	Jan. '23, M	0.05
Homestake Mining	New York	75	75	75	Jan '23, M	0.50
Keora	Toronto	*10⅛	*9¾	*10¼		
Kirkland Lake	Toronto	*40	*39¼	*40		
Lake Shore	Toronto	3.43	3.18	3.40	Nov. '22, Q	0.02
McIntyre- Porcupine	Toronto	19.75	18.70	19.50	Jan. '23, K	0.25
Porcupine Crown	Toronto	*17	*16½	*12	July '17,	0.03
Portland	Colo. Springs			*40	Oct. '20, Q	0.01
Schumacher	Toronto	*30	*29½	*30		
Teck Hughes	Toronto	*96½	*91¼	*95		
Tom Reed	Los Angeles	1.39	1.15	1.17	Dec. '19,	0.02
United Eastern	N. Y. Curb	2¼	1⅞	2 1/16	Jan. '23, Q	0.15
Vipond Cons.	Toronto			*68		
White Caps Mining	N. Y. Curb	*7	*5	*7		
Wright-Hargreaves	Toronto	3.29	3.15	3.29	Jan. '23,	0.02½
Yukon Gold	N. Y. Curb	*80	*76	*80	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*12	*9	*10		
Cons. Virginia	San Francisco	*10½	*10½	*10½		
Continental Mines	N. Y. Curb	5	4½	5		
Dolores Esperanza	N. Y. Curb	2	1½	2	Jan. '23	2.50
Tonopah Belmont	N. Y. Curb	1 7/16	1⅜	1⅜	Jan. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*70	*62	*70		
Tonopah Extension	N. Y. Curb	3⅜	2 15/16	3 1/16	Jan. '23, Q	0.05
Tonopah Mining	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '23, SA,	0.15
West End Consol.	N. Y. Curb	1⅜	1 7/16	1⅜	Dec. '22, Q	0.05
SILVER-LEAD						
Caledonia Mng.	N. Y. Curb	*9	*9	*9	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*32	*31½	*31½	Dec. '20,	0 15
Chief Consol.	Boston Curb	4⅞	4¼	4⅜	Feb. '23, Q	0.10
Columbus Rexall	Salt Lake	*20	*20	*20	Aug. '22,	0.03
Consol. M. & S.	Montreal	28	28	28	Oct. '20, Q	0.62½
Eagle & Blue Bell	Boston Curb	†3	†2	3	Nov. '22, K	0.05
Federal M. & S.	New York			9⅛	Jan '09,	1.50
Federal M. & S. pfd.	New York	50⅜	46½	50½	Dec. '22, Q	1.25
Florence Silver	Spokane	*38½	*38	*38	Apr. '19,	0.01½
Hecla Mining	N. Y. Curb	8⅛	8⅛	8⅛	Dec. '22, Q, X	0.50
Iron Blossom Con.	N. Y. Curb	*32	*30	*31	Apr. '22, Q	0.02½
Mars Mines	N. Y. Curb	*8	*8	*8	June '21, I	0.02
Park City	Salt Lake	3.40	3.37½	3.37½	Jan. '23,	0.10
Prince Consol.	Salt Lake	*11⅛	*8½	*8½	Nov. '17,	0.02½
Silversmith	Spokane	*48½	†45	*45	Oct '22,	0.01
Simon Silver Lead	N. Y. Curb	*34	*31	*31		
Tamarack-Custer	Spokane	1 50	1.30	1.50	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.65	2.50	2.55	Dec. '22, Q, X	0.10
Utah Apex	Boston	3⅛	3⅛	3⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel "B"	New York	65⅜	61⅛	65⅜	Jan. '23	0.25
Char. Iron	Detroit			1¼		
Char. Iron, pfd	Detroit			2¼		
Colorado Fuel & Iron	New York	29	25¼	29	May '21	0.75
Col. Fuel & Iron, pfd.	New York			105	Nov. '22	2.00
Gt. North'n Iron Ore	New York	31⅛	30⅛	31⅛	Dec. '22	1.00
Inland Steel	N. Y. Curb			47	Dec. '22	0.25
Mesabi Iron	N. Y. Curb	11	10⅛	10⅛		
Replogle Steel	New York	29	25½	29		
Republic I. & S.	New York	55	48⅛	54⅞	May '21	1.50
Republic I. S., pfd.	New York	92¾	90⅛	92⅜	Jan. '22	1.75
Sloss-Sheffield S. & I.	New York	49	46⅛	49	Feb. '21	1.50
U. S. Steel	New York	107⅛	105⅜	107⅛	Dec. '22	1.25
U. S. Steel, pfd.	New York	121	119¾	120⅛	Feb. '23	1.75
Virginia I. C. & C.	New York	53⅛	53⅛	53⅜	Jan. '22	1.50
Virginia I.C.&C., pfd.	New York			80	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	39⅜	36⅛	39	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	70	70	70	Oct. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	87	87	87	Oct. '22, Q	1.75
SULPHUR						
Freeport Texas	New York	21⅛	20	21⅛	Nov. '19, Q	1.00
Texas Gulf	New York	63⅜	60⅛	61⅛	Dec. '22, QX	2.00
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	53⅜	51⅛	53⅛	Dec. '22, Q	0.75
Amer. Metal pfd.	New York	117	115	117	Dec. '22, Q	1.75
Amer. Sm. & Ref.	New York	64½	57	63⅜	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	101	100	101	Dec. '22 Q	1.75
U. S. Sm. R. & M.	New York	38	34⅛	38	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	46	45	45	Jan. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

Recording Shaft Signal Device Sought

The Prevention of Accidents Committee of the Rand Mutual Assurance Co., Ltd., Johannesburg, Transvaal, offers prize money not exceeding £250 for a design or designs of the most practicable device for recording shaft signals at mines. The device must be capable of making a permanent record showing clearly and separately the following: The time and nature of all signals received by the hoistman, (a) from underground, and (b) from the shaft collar; the time and nature of all signals given by the hoistman, (a) to underground, and (b) to the shaft collar; the conveyance or compartment (if any) to which the signals mentioned in the above refer, and the time during which each conveyance is in motion. While it would be an advantage to have a device recording the speed and direction of the motion, this is not essential. There is no entrance fee and the competition is open to all, including mercantile firms.

The following conditions will apply to the competition:

1. The device must be capable of being installed on existing plants at a moderate cost.

2. It must be capable of being kept in efficient working condition without undue expense.

3. If the device has been in practical use, particulars must be supplied.

4. Models, drawings, plans, photographs, or other descriptions of the device must be submitted, from which a full-size working appliance is capable of being constructed. These must be accompanied by an estimate giving the approximate cost of equipping a typical engine with the device, and the royalty (if any) payable for its use if the device is patented.

5. The full name and address of each competitor must be given; also a statement as to whether the device is patented or not and when and where a model of the invention can be seen.

6. Entries close on Sept. 30, 1923, and must reach the undersigned on or before that date.

7. The Prevention of Accidents Committee reserves to itself the right to reduce or withdraw the prize money if in its opinion none of the designs submitted are considered to be sufficiently worthy.

Competitors are warned that the committee will not be responsible for any risks which competitors take in regard to the disclosure of any patentable idea and are advised that any such idea should first be protected provisionally or otherwise.

The acceptance of a prize does not necessarily imply that the competitor has sold his idea. It will be open for any competitor to stipulate that a royalty or fee shall be paid to him for the use of any patented device on any mine on which it may be installed; but the committee does not undertake that any such device will be installed or that any such royalty or fee will be paid.

All communications should be addressed to J. F. Bilbrough, Managing Secretary, The Rand Mutual Assurance Co., Ltd., P. O. Box 413, Johannesburg, Transvaal, South Africa.

INDUSTRIAL NOTES

The Atlantic Refining Co. has purchased a tract of 500 acres five miles southeast of Port Arthur, Tex., where it will build an oil refinery. Plans are now being drawn.

Julio Seckbach, buyer of ores and metals, announces the removal of his office and laboratory to 6a Gabino Barreda 118 (Colonia San Rafael), Mexico City, Mexico.

Paul T. Buckler, for fourteen years with the Detroit Stoker Co. as manager successively of the Pittsburgh, Cleveland, and New York offices, is now with the New York office of the Power Specialty Co.

William P. Waugh, consulting engineer for the H. H. Robertson Co., of Pittsburgh, died at his home at Sewickley, Pa., on Jan. 15. Mr. Waugh was born in Hedrick, Iowa, and attended Iowa State College, at Ames, Iowa.

A. E. Ensell, formerly with the Equipment Corporation of America, is now engaged in the purchase, sale, or rental of contractor's, railroad, mine, mill and quarry equipment, and is at 1628 Market St., Philadelphia, Pa.

L. M. Keating, who has been connected with the Mansfield office of the Ohio Brass Co. for a number of years, has been transferred to the outside sales organization of that company. He will take up his new duties about March 1, with offices in El Paso, Tex.

The Western Precipitation Co. has moved its eastern office from Philadelphia to New York. This applies as well to the office of the subsidiary company, the International Precipitation Co. The eastern office is now in the same quarters as those occupied by their associates, the Research Corporation, 25 West 43d St., New York.

David Cochrane, the inventor, designer and first builder of the open-feed water heater which bears his name, died on Jan. 24. Mr. Cochrane was born in Sawkey, Clackmanmonshire, Scotland, in 1850, and in his early years worked as a pattern maker on the Clyde. In 1879 he came to the United States, where he entered the employment of Ferris & Miles, but he soon afterward went with the Harrison Safety Boiler Works. Mr. Cochrane was also the first to design a successful oil separator. a heater and receiver. He was frequently consulted on design of steam plants, and his contribution to steam engineering consisted in focusing attention on more efficient utilization of exhaust steam.

TRADE CATALOGS

Sand and Slime Cones — The Allen Cone Co., El Paso, Tex., has issued bulletin No. 22, which describes and illustrates the several types of cones manufactured by the company. These include the Allen sand cone, ball and mill tube classifiers, and similar devices. Functions, dimensions, and capacities are given.

Speed Reducers—The W. A. Jones Foundry & Machine Co., Chicago, Ill., has recently issued catalog No. 26, "Jones Spur Gear Speed Reducers." This catalog is most complete as to information and illustrations. Descriptions, advantages, adaptability and range of application, and details of design and operation are included. Several tables are also given.

Joint Pipe—The National Tube Co., Pittsburgh, Pa., has just issued a most attractive book of 64 pages entitled "'National' Matheson Joint Pipe." The illustrations, decorations, and printing are of a high order and quite in keeping with the presentation of the subject. The methods followed in the manufacture of the joint pipe, its advantages, and the protective coverings and reinforcement used are detailed and much valuable information is given. Curves and tables are included.

Centrifugal Pumps — Small single-stage centrifugal pumps for motor or belt drive are described in a leaflet and in an instruction manual issued by the De Laval Steam Turbine Co., Trenton, N. J. These pumps are made in 1½ and 2 in. sizes, and are designed for capacities ranging from 5 gal. per minute against 10 ft. head up to 130 gal. per minute against 150 ft. head. They contain few and simple parts, which are manufactured to limit gages to insure interchangeability. The publications give very complete tables and instructions for selecting pumps for different conditions, and explain how to determine the proper speeds and how to select piping, valves, fittings, and driving pulley or motor to secure an efficient and satisfactory installation.

Quenching Tanks—The W. S. Rockwell Co., 30 Church St., New York, has issued circular No. 245, which describes the Rockwell combination automatic heating-cooling unit. The automatic rotary quenching tank, which has been teamed up with the furnace, is a comparatively new development and supplies an entirely automatic cooling unit built on the same proven principles which have been found to work successfully with the rotary furnace. Improper cooling is responsible for much of the loss in heat-treating operations. By the use of this automatic quenching tank the chances for trouble are practically eliminated, because each piece is automatically cooled in the same manner, for the same time, at the same rate, and at the required temperature.